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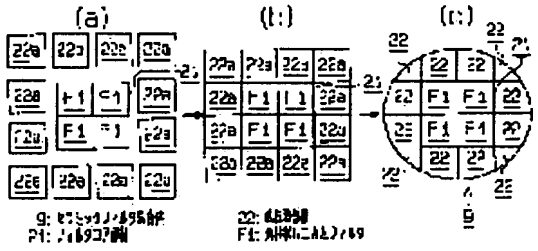
(54) CERAMIC FILTER ASSEMBLY

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a ceramic filter assembly having excellent strength and reproduction efficiency.
SOLUTION: The ceramic filter assembly 9 has filter core members 21 and low-thermal conductivity members 22. The members 21 are formed by bonding the outer peripheral surfaces of a plurality of prismatic honeycomb filters F1 to each other across ceramic sealing material layers. The prismatic honeycomb filters F1 consist of porous ceramic bodies of a non-oxide system essentially consisting of silicon carbide. The members 22 consist of ceramic materials having the lower thermal conductivity than the thermal conductivity of the porous ceramic bodies forming the members 21. The members 22 are bonded across the ceramic sealing material layers on the outer peripheral surfaces of the members 21 in the state of being arranged on the outer sides of the members 21.



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CLAIMS

[Claim(s)]
[Claim 1] By banding together through the nature sealant layer of a ceramic, the peripheral faces of two or more pillar-shaped honeycomb filters which consist of a ceramic porous body of the non-oxide system which uses silicon carbide as a principal component It consists of an ingredient with thermal conductivity lower than the ceramic porous body which constitutes the filter core member which comes to unify said each honeycomb filter, and said filter core member. The ceramic filter aggregate equipped with the low heat-conduction member which banded together through the nature sealant layer of a ceramic to the peripheral face of this filter core member in the condition of having been arranged on the outside of said filter core member.
[Claim 2] By banding together through the nature sealant layer of a ceramic, the peripheral faces of two or more pillar-shaped honeycomb filters which consist of a ceramic porous body of the non-oxide system which uses silicon carbide as a principal component The filter core member which comes to unite said each honeycomb filter with a prismatic form, It consists of a ceramic ingredient with thermal conductivity lower than the ceramic porous body which constitutes said filter core member. The 1st low heat-conduction member which banded together through the nature sealant layer of a ceramic to the peripheral face of this filter core member in the condition of having been arranged at the side outside side of said filter core member, While consisting of a ceramic ingredient with still lower thermal conductivity and being arranged on the corner outside of said filter core member rather than the ceramic ingredient which constitutes said 1st low heat-conduction member The ceramic filter aggregate equipped with the 2nd low heat-conduction member which banded together through the nature sealant layer of a ceramic to said adjoining peripheral face of the 1st low heat-conduction member.
[Claim 3] Said low heat-conduction member is the ceramic filter aggregate according to claim 1 or 2 characterized by being a ceramic porous body.
[Claim 4] Said low heat-conduction member is the ceramic filter aggregate according to claim 3 characterized by being the honeycomb structure object with which the edge of the cel of a large number prolonged along the direction of an axis was closed by turns.
[Claim 5] Said low heat-conduction member is the ceramic filter aggregate given in claim 1 characterized by consisting of a ceramic ingredient with a degree of hardness lower than the ceramic porous body which constitutes said filter core member thru/or any 1 term of 4.
[Claim 6] Said low heat-conduction member is the ceramic filter aggregate according to claim 5 characterized by being a product made from porosity cordierite.
[Claim 7] Said ceramic filter aggregate is the ceramic filter aggregate given in claim 1 characterized by being a cross-section circle configuration or cross-section elliptical thru/or any 1 term of 6.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the ceramic filter aggregate constituted including the member which pasted up two or more pillar-shaped honeycomb filters through the nature sealant layer of a ceramic.
[0002]
[Description of the Prior Art] The number of an automobile is increasing by leaps and bounds after the 20th century, and the increment of it also with the rapid amount of the exhaust gas taken out by the internal combustion engine of an automobile in proportion to it is being enhanced. Since the various matter contained in the exhaust gas which especially a diesel power plant takes out becomes the cause which causes contamination, in current, it is having effect serious for a world environment. Moreover, the research result that the particle in exhaust gas (diesel particulate) becomes the cause which sometimes causes reduction of an allergy failure or a sperm count is also reported by recently. That is, it is considered to be a urgent technical problem for human beings to take the cure which removes the particle in exhaust gas.
[0003] Metal casing is prepared in the way of the exhaust pipe connected with the engine exhaust manifold under such circumstances, and the exhaust gas purge of the structure which has arranged the ceramic filter aggregate in it is proposed. The ceramic filter aggregate means the thing which pastes up and comes to unify the peripheral faces of two or more prismatic form honeycomb filters which consist of a ceramic porous body through the nature sealant layer of a ceramic. Here describes the manufacture approach of the aggregate in the former briefly.
[0004] First, a square pole-like honeycomb Plastic solid is formed by extruding a ceramic raw material continuously through the metal mold of an extruding press machine. After cutting a honeycomb Plastic solid to equal die length, the cutting piece is degreased and calcinated and it considers as a honeycomb filter. After a baking process, the nature sealant of a ceramic is applied to the peripheral face of a honeycomb filter at homogeneity, and union unification is carried out. And the cross-section circle configuration or cross-section elliptical ceramic filter aggregate is obtained by carrying out the grinding process of the periphery part of such the filter structure. And an exhaust gas purge is eventually completed by twisting a heat insulator around the peripheral face of the above-mentioned aggregate, and holding in casing in which the aggregate was prepared by the way of an exhaust pipe.
[0005]
[Problem(s) to be Solved by the Invention] However, in the case of the ceramic filter aggregate of the above-mentioned conventional technique, heat is in recess or the inclination which becomes empty for the way of the aggregate periphery section to become low temperature compared with an aggregate core so, from the aggregate periphery section at a casing side. Therefore, the stress resulting from a temperature gradient occurs in the aggregate, as a result it becomes easy to damage the aggregate by the thermal shock. Moreover, the cinder of soot arises in the aggregate periphery section which temperature cannot go up fully easily, and there is a possibility that regeneration efficiency may worsen.
[0006] Furthermore, when the non-oxide system ceramic ingredient represented by silicon carbide (SiC) is used as a charge of filter lumber, in order to prepare the appearance of the whole aggregate, cutting needs to remove some hard honeycomb filters. So, in addition to manufacture being troublesome, there is a problem of being easy to become cost high.
[0007] This invention is made in view of the above-mentioned technical problem, and the 1st object is in offering the ceramic filter aggregate excellent in reinforcement and regeneration efficiency. The 2nd object of this invention has manufacture in offering the easy and, comparatively cheap ceramic filter aggregate further.
[0008]
[Means for Solving the Problem] In order to solve the above-mentioned technical problem, in invention according to claim 1 By banding together through the nature sealant layer of a ceramic, the peripheral faces of two or more pillar-shaped honeycomb filters which consist of a ceramic porous body of the non-oxide system which uses silicon carbide as a principal component It consists of an ingredient with thermal conductivity lower than the ceramic porous body which constitutes the filter core member which comes to unify said each honeycomb filter, and said filter core member. Let the ceramic filter aggregate equipped with the low heat-conduction member which banded together through the nature sealant layer of a ceramic to the peripheral face of this filter core member in the condition of having been arranged on the outside of said filter core member be the summary.
[0009] The peripheral faces of two or more pillar-shaped honeycomb filters which consist of a ceramic porous body of the non-oxide system which uses silicon carbide as a principal component in invention according to claim 2 by banding together through the nature sealant layer of a ceramic The filter core member which comes to unite said each honeycomb filter with a prismatic form, It consists of a ceramic ingredient with thermal conductivity lower than the ceramic porous body which constitutes said filter core member. The 1st low heat-conduction member which banded together through the nature sealant layer of a ceramic to the peripheral face of this filter core member in the condition of having been arranged at the side outside side of said filter core member, While consisting of a ceramic ingredient with still lower thermal conductivity and being arranged on the corner outside of said filter core member rather than the ceramic ingredient which constitutes said 1st low heat-conduction member Let the ceramic filter aggregate equipped with the 2nd low heat-conduction member which banded together through the nature sealant layer of a ceramic to said adjoining peripheral face of the 1st low heat-conduction member be the summary.
[0010] In claims 1 or 2, said low heat-conduction member presupposed that it is invention according to claim 3 a ceramic porous body. In claim 3, said low heat-conduction member presupposed that it is invention according to claim 4 the honeycomb structure object with which the edge of the cel of a large number prolonged along the direction of an axis was closed by turns.
[0011] Invention according to claim 5 presupposed that said low heat-conduction member consists of a ceramic ingredient with a degree of hardness lower than the ceramic porous body which constitutes said filter core member in claim 1 thru/or any 1 term of 4.

[0012] In claim 5, said low heat-conduction member presupposed that it is invention according to claim 6 a product made from porosity cordierite. In claim 1 thru/or any 1 term of 6, said ceramic filter aggregate presupposed that it is a cross-section circle configuration or cross-section elliptical invention according to claim 7.
[0013] Hereafter, "an operation" of this invention is explained. According to invention according to claim 1, by having arranged the low heat-conduction member, the adiabatic efficiency in the aggregate periphery section becomes high, and heat recess-comes to be hard from an aggregate peripheral face to a casing side. Consequently, it becomes easy to go up the temperature of the aggregate periphery section, and a temperature gradient with an aggregate core becomes small. Therefore, it is hard coming to generate big stress, and breakage of the aggregate by the thermal shock is prevented. Moreover, it is hard coming to generate the cinder of soot, and regeneration efficiency also improves. Moreover, the unusual combustion beyond the limitation of the filter by the cinder of soot can be suppressed.
[0014] According to invention according to claim 2, in addition to an operation according to claim 1, the following operation is done so. Since the way of the corner outside part of a filter core member usually becomes far from a center section compared with the side outside side part of a filter core member, it is hard to go up temperature, and heat is recess and a cone to a casing side. Then, adiabatic efficiency can be more certainly raised by making thermal conductivity of the corner outside part of a filter core member still lower than the thermal conductivity of the side outside side part of a filter core member.
[0015] If it is the low heat-conduction member which consists of a ceramic porous body according to invention according to claim 3, since itself will function as some filters, even if not accompanied by enlargement of a filter core member, predetermined filtration capacity is maintained. Moreover, coefficient of thermal expansion can also use an equivalent thing, without it seeming that the thermal resistance of the aggregate is spoiled since a ceramic ingredient is generally strong with heat.
[0016] According to invention according to claim 4, the filtration capacity of an aggregate is certainly maintainable on high level by using the above-mentioned honeycomb structure object as a low heat-conduction member.
[0017] If it is the low heat-conduction member which consists of a ceramic ingredient with a low degree of hardness relatively according to invention according to claim 5, in order to prepare the appearance of the whole aggregate, it will become comparatively easy to remove a part of low heat-conduction member. Therefore, manufacture can consider as the aggregate that it is not so troublesome and cheap.
[0018] According to invention according to claim 6, since not hard but porosity cordierite is moreover as cheap as the ceramic porous body of the non-oxide system which uses silicon carbide as a principal component, it is very suitable as a formation ingredient of a low heat-conduction member.
[0019]
[Embodiment of the Invention] The exhaust gas purge 1 for the diesel power plants of 1 operation gestalt which materialized this invention is explained to a detail based on drawing 1 - drawing 4 (c) below [the 1st operation gestalt].
[0020] As shown in drawing 1 , this exhaust gas purge 1 is equipment for purifying the exhaust gas discharged from the diesel power plant 2 as an internal combustion engine. The diesel power plant 2 is equipped with two or more cylinders which are not illustrated. The tee 4 of the exhaust manifold 3 which consists of a metallic material is connected with each cylinder, respectively. Each tee 4 is connected to one manifold body 5, respectively. Therefore, the exhaust gas discharged from each cylinder is concentrated on one place.
[0021] The 1st exhaust pipe 6 and the 2nd exhaust pipe 7 which consist of a metallic material are arranged in the downstream of an exhaust manifold 3. The upstream edge of the 1st exhaust pipe 6 is connected with the manifold body 5. Between the 1st exhaust pipe 6 and the 2nd exhaust pipe 7, the tubed casing 8 which similarly consists of a metallic material is arranged. The upstream edge of casing 8 is connected with the downstream edge of the 1st exhaust pipe 6, and the downstream edge of casing 8 is connected with the upstream edge of the 2nd exhaust pipe 7. It can also be grasped that casing 8 is arranged in the way of exhaust pipes 6 and 7. And as a result, the contrant region of the 1st exhaust pipe 6, casing 8, and the 2nd exhaust pipe 7 is mutually open for free passage, and exhaust gas flows the inside of it.
[0022] As shown in drawing 1 , casing 8 is formed so that the center section may serve as a major diameter from exhaust pipes 6 and 7. Therefore, the contrant region of casing 8 is large compared with the contrant region of exhaust pipes 6 and 7. The ceramic filter aggregate 9 is held in this casing 8.
[0023] Between the peripheral face of the aggregate 9, and the inner skin of casing 8, the heat insulator 10 with which the aggregate 9 consisted of another objects is arranged. A heat insulator 10 is the mat-like object formed including ceramic fiber, and the thickness is several mm - dozens of mm. A heat insulator 10 is good to have thermal expansion nature. Since thermal expansion nature here has elastic structure, it points out that there is a function to release thermal stress. The reason is for suppressing the energy loss at the time of playback to the minimum by preventing that heat escapes from the outermost periphery of the aggregate 9. Moreover, since it has elastic structure, a location gap of the ceramic filter aggregate 9 brought [oscillation / the pressure of exhaust gas, / by transit] about can be prevented.
[0024] Since the ceramic filter aggregate 9 used in this operation gestalt is what removes a diesel particulate like the above, generally it is called a diesel particulate filter (DPF).
[0025] This ceramic filter aggregate 9 is constituted by the filter core member 21 and the low heat-conduction member 22. The filter core member 21 is arranged in the core of the aggregate 9. The filter core member 21 has the structure which pasted up two or more pillar-shaped honeycomb filters F1, and was unified. In the honeycomb filter F1 of this operation gestalt, each cross section of the direction which intersects perpendicularly to the direction of an axis has become square-like. The cross section of filter core member 21 the very thing is also a square.
[0026] As shown in drawing 2 and drawing 3 , these filters F1 are the so-called honeycomb structure objects. The reason for having adopted the honeycomb structure object is that there is an advantage that pressure loss is small even when the amount of uptake of a particle increases. Two or more breakthroughs 12 which make the shape of a cross-section abbreviation square are regularly formed in each honeycomb filter F1 along the direction of an axis. Each breakthrough 12 is mutually divided with the thin cell wall 13. The oxidation catalyst which consists of platinum group metals (for example, Pt etc.), other metallic elements, its oxide, etc. is supported by the internal surface of a cel.
[0027] Opening of each breakthrough 12 is closed with the closure object 14 (here porosity silicon carbide sintered compact) at the end-faces [one of]a [9] and 9b side. Therefore, if it sees as end-face 9a and the whole 9b, the shape of a checker is presented. Consequently, the cel of a large number which carried out the shape of a cross-section square is formed in the honeycomb filter F1. The consistency of a cel is set up before and after a 100-400-piece [/square] inch, and the thickness of a cell wall 13 is about 0.05-0.5mm. In upstream end-face 9a, opening of the thing of an abbreviation moiety is carried out among a large number cels, and opening of the remaining things is carried out in downstream end-face 9b.
[0028] The average pore diameter of a honeycomb filter F1 is 1 micrometer - 50 micrometers. The blinding of the honeycomb filter F1

according that an average pore diameter is less than 1 micrometer to deposition of a particle becomes remarkable. On the other hand, since it becomes impossible to carry out uptake of the fine particle when an average pore diameter exceeds 50 micrometers, collection efficiency will fall remarkably.

[0029] As for the porosity of a honeycomb filter F1, it is desirable that they are 30% - 80% and 35 more% - 70%. A honeycomb filter F1 becomes it precise that porosity is less than 30% too much, and there is a possibility that it may become impossible to circulate exhaust gas inside. On the other hand, when porosity exceeds 80%, there is a possibility that may become weak in reinforcement and the collection efficiency of a particle may fall into a honeycomb filter F1 since an opening increases too much.

[0030] As shown in drawing 2 and drawing 3 , the peripheral face of a total of four honeycomb filters F1 is mutually pasted up through the nature sealant layer 15 of a ceramic. The nature sealant layer 15 of a ceramic contains the inorganic binder, the organic binder, and the inorganic fiber (specifically ceramic fiber) during the presentation. The reason for having chosen ceramic fiber is that suitable thermal resistance is given since ceramic fiber is excellent in thermal resistance. As said ceramic fiber, at least one or more sorts of things chosen from a silica-alumina fiber, a mullite fiber, an alumina fiber, and a silica fiber are mentioned, for example. Also in these, it is desirable to choose a silica-alumina fiber especially. A silica-alumina fiber is because the operation which absorbs thermal stress is shown while excelling in elasticity. In addition, as for the fiber content in the nature sealant layer 15 of a ceramic, it is good that it is 10 % of the weight - 40 % of the weight in solid content, and, as for the fiber length of ceramic fiber, it is good that it is 10 micrometers - 3000 micrometers. As for the thickness of the nature sealant layer 15 of a ceramic, it is good that it is 0.1mm - 3mm, and it is good that it is 0.3 moremm - 1mm.

[0031] On the other hand, the low heat-conduction member 22 is pasted up on the peripheral face of this filter core member 21 through the nature sealant layer 15 of a ceramic in the condition of having been arranged on the outside of the filter core member 21. In addition, the presentation of the nature sealant layer 15 of a ceramic may be the same as what is used for adhesion between honeycomb filters F1, and also may differ. The same thing is chosen with this operation gestalt. Of course, such a nature sealant layer 15 of a ceramic may be used for adhesion between the low heat-conduction members 22.

[0032] The above-mentioned prismatic form honeycomb filter F1 consists of a ceramic porous body of the non-oxide system which uses silicon carbide as a principal component. The reason is that such a ceramic porous body is extremely excellent in thermal resistance, a mechanical strength, and thermal conductivity as compared with other non-oxide system ceramic porous bodies. It says that a part for silicon carbide is included 50% or more by the weight ratio during a presentation, saying "let silicon carbide be a principal component." Therefore, what contains a part for silicon carbide 50% or more by the weight ratio during a presentation, and it is more nearly little than it, and also contains matter (for example, silicon, nitrogen, etc.) corresponds to the ceramic porous body of the non-oxide system which uses silicon carbide as a principal component. In addition, with this operation gestalt, the ceramic porous body (high grade porosity silicon carbide sintered compact) which contains a part for silicon carbide 99% of the weight or more is used.

[0033] The above-mentioned low heat-conduction member 22 consists of a ceramic ingredient with thermal conductivity lower than the ceramic porous body which constitutes the filter core member 21. Therefore, the low heat-conduction member 22 needs to consist of a ceramic ingredient with thermal conductivity lower than a high grade porosity silicon carbide sintered compact with this operation gestalt using the filter core member 21 made from a high grade porosity silicon carbide sintered compact.

[0034] As for the low heat-conduction member 22, it is good that they are a porous body, especially a ceramic porous body. As an example of a suitable ceramic porous body, porous bodies, such as cordierite (2MgO, 2aluminum2O3, and 5SiO2), an alumina (aluminum 2O3), and a mullite (3aluminum2O3 and 2SiO2), are mentioned. As a low heat-conduction member 22, it is especially desirable to consist of a ceramic porous body of the oxide system which contains oxidation silicon as one component. In addition, as for the low heat-conduction member 22, it is good that it is the honeycomb structure object with which the edge of the cel of a large number prolonged along the direction of an axis was closed by turns.

[0035] It is because itself functions as some filters, so predetermined filtration capacity will be maintained even if not accompanied by enlargement of the filter core member 21 if it is the low heat-conduction member 22 which consists of a ceramic porous body. Moreover, it is because a ceramic ingredient is generally strong with heat, so the suitable thermal resistance of the aggregate 9 will be maintained if this is used. In addition, it is good for the cell wall of said honeycomb structure object to support the oxidation catalyst like a honeycomb filter F1.

[0036] Moreover, as for the above-mentioned low heat-conduction member 22, it is desirable to consist of a ceramic ingredient with a degree of hardness lower than the ceramic porous body (here high grade porosity silicon carbide sintered compact) which constitutes the filter core member 21. The reason is possible [performing an appearance cut process easily], if a degree of hardness is relatively low compared with a high grade porosity silicon carbide sintered compact. From the above thing, the low heat-conduction member 22 made from porosity cordierite is used with this operation gestalt. That is, it is because not hard but it is moreover cheap, so porosity cordierite is [high temperature being conductivity and] very as suitable as the ceramic porous body of the non-oxide system which uses silicon carbide as a principal component as a formation ingredient of the low heat-conduction member 22. Moreover, it is because it is possible to produce a porosity honeycomb structure object easily.

[0037] It is better to make lower than the ceramic porous body which constitutes the filter core member 21 the thermal conductivity of the ceramic ingredient which it is good that it is 1 W/m-K - 200 W/m-K here as for the 500-degree C thermal conductivity of the ceramic porous body which constitutes the filter core member 21, and constitutes the low heat-conduction member 22.

[0038] When the thermal conductivity of the ceramic porous body which constitutes the filter core member 21 is too small, there is a possibility of leading to generating of the thermal stress which it becomes easy to produce a temperature gradient and causes a crack in the filter core member 21. When it is going to enlarge the thermal conductivity of the ceramic porous body which constitutes the filter core member 21, selection of an ingredient, setting out of baking conditions, etc. become difficult, and there is a possibility of causing the jump of a manufacturing cost. When the thermal conductivity of the ceramic ingredient which constitutes the low heat-conduction member 22 is too large, it becomes impossible to fully heighten the adiabatic efficiency in the periphery section of the aggregate 9. It becomes impossible therefore, to reduce effectively the heating value which escapes from the peripheral face of the aggregate 9 to a casing 8 side.

[0039] It is better to make relatively Vickers hardness number of the ceramic ingredient which it is good that 1500-3000kg /is [mm] 2 as for the Vickers hardness number of the ceramic porous body which constitutes the filter core member 21, and constitutes the low heat-conduction member 22 lower than the ceramic porous body which constitutes the filter core member 21.

[0040] If the ceramic porous body which constitutes the filter core member 21 is too soft, lowering of the filter core member 21 on the strength, as a result lowering of the aggregate 9 whole on the strength will be caused, and it will become the aggregate 9 inferior to endurance. When it is going to make harder than the above-mentioned value the ceramic porous body which constitutes the filter core member 21, selection of an ingredient, setting out of baking conditions, etc. become difficult, and there is a possibility of causing the jump of a manufacturing cost. When the ceramic ingredient which constitutes the low heat-conduction member 22 is too soft, while

there is an advantage which is easy to carry out a grinding process at the time of manufacture, it becomes easy to generate a crack etc. at the time of an activity. Therefore, there is a possibility of leading to lowering of the aggregate 9 whole on the strength.
[0041] In the completed aggregate 9, the cross-section configuration of the low heat-conduction member 22 has turned into the configuration different from each honeycomb filter F1 which constitutes the filter core member 21, i.e., a variant pillar-shaped member. One peripheral face in the low heat-conduction member 22 is the convex curved surface made by being removed by the grinding process. This convex curved surface constitutes a part of peripheral face of the aggregate 9. In addition, these low heat-conduction member 22 is presenting the same cross-section configuration as each honeycomb filter F1 in the phase in early stages of manufacture. The number of the low heat-conduction members 22 used for the one aggregate 9 is 12, and the outside of the filter core member 21 will be thoroughly surrounded it by them. And if it sees as the aggregate 9 whole, the cylinder-like ceramic filter aggregate 9 (before or after the diameter of 135mm) is constituted.
[0042] Next, the procedure of manufacturing the above-mentioned ceramic filter aggregate 9 is explained based on drawing 4 (a) - (c). First, the paste for closure used for the ceramic raw material slurry used at the time of extrusion molding and end-face closure and the paste 18 for sealant layers used at an adhesion process are produced beforehand. About a ceramic raw material slurry, two sorts for object [for the filter core members 21] and low heat-conduction member 22 are prepared.
(Production of the honeycomb filter F1 for filter core member 21) What blended an organic binder and water the predetermined daily dose every, and kneaded them to silicon carbide powder as a ceramic raw material slurry for honeycomb filter F1 formation is used. What blended and kneaded an organic binder, lubricant, a plasticizer, and water to silicon carbide powder as a paste for closure is used. What blended an inorganic fiber, an inorganic binder, an organic binder, an inorganic particle, and water the predetermined daily dose every, and kneaded them as a paste 18 for sealant layers is used.
[0043] Next, said ceramic raw material slurry is supplied to an extruding press machine, and it is continuously extruded through metal mold. Then, the honeycomb Plastic solid by which extrusion molding was carried out is cut to equal die length, and a square pole-like honeycomb Plastic solid cutting piece is obtained. Furthermore, single-sided opening of each cel of a cutting piece is filled up with the paste for specified quantity [every] closure, and the ends side of each cutting piece is closed.
[0044] Then, calcinate by setting temperature, time amount, etc. as predetermined conditions, and degreasing, a honeycomb Plastic solid cutting piece and the closure object 14 are made to sinter thoroughly, and four honeycomb filters F1 made from a square pole-like porosity silicon carbide sintered compact are obtained.
[0045] In addition, in order to set an average pore diameter to 6 micrometers - 15 micrometers and to make porosity into 35% - 50%, with this operation gestalt, burning temperature was set as 2100 degrees C - 2300 degrees C, and firing time is set up in 0.1 hours - 5 hours. Moreover, the furnace atmosphere at the time of baking is made into an inert atmosphere, and the pressure of the ambient atmosphere at that time is made into ordinary pressure.
[0046] Next, after forming the substrate layer which becomes the peripheral face of a honeycomb filter F1 from the quality of a ceramic if needed, the paste 18 for sealant layers is further applied on it. And the cross-section square-like filter core member 21 is obtained by pasting up the peripheral faces of four honeycomb filters F1, and unifying.
(Production of the low heat-conduction member 22) After grinding and carrying out grain refining of the raw material which consists of a kaolin, an alumina, and talc as a ceramic raw material slurry for low heat-conduction member 22 formation, what blended an organic binder and water the predetermined daily dose every, and kneaded them is used. What blended and kneaded an organic binder, lubricant, a plasticizer, and water to what ground and carried out grain refining of the raw material which consists of a kaolin, an alumina, and talc as a paste for closure is used. The above-mentioned thing is diverted as a paste 18 for sealant layers.
[0047] Next, said ceramic raw material slurry is supplied to an extruding press machine, and it is continuously extruded through metal mold. Then, the honeycomb Plastic solid by which extrusion molding was carried out is cut to equal die length, and a square pole-like honeycomb Plastic solid cutting piece is obtained. Furthermore, single-sided opening of each cel of a cutting piece is filled up with the paste for specified quantity [every] closure, and the ends side of each cutting piece is closed.
[0048] Then, calcinate by setting temperature, time amount, etc. as well-known conditions conventionally, and degreasing, a honeycomb Plastic solid cutting piece and the closure object 14 are made to sinter thoroughly, and pillar-shaped member 22a made from a prismatic form porosity cordierite sintered compact is obtained.
(Adhesion process) Next, after forming the substrate layer which also becomes the peripheral face of pillar-shaped member 22a from the quality of a ceramic if needed, the paste 18 for sealant layers is further applied on it. And 12 pillar-shaped member 22a is arranged on the outside of the filter core member 21, and the peripheral face of each pillar-shaped member 22a is pasted up on the peripheral face of the filter core member 21 in this condition. Consequently, the filter bonded structure object M which consists of a filter core member 21 and pillar-shaped member 22a is obtained. As shown in drawing 4 (a) and (b), at this event, the filter bonded structure object M is still presenting the shape of a cross-section square as a whole.
(Appearance cut process) At the continuing appearance cut process, grinding of the filter bonded structure object M of the shape of a cross-section square pass the adhesion process is carried out, the garbage in the periphery section is removed, and the appearance is prepared. Grinding of a part of each pillar-shaped member 22a arranged as surrounds the whole periphery of the filter core member 21 is carried out in curved surface, and, specifically, it is removed. Consequently, the filter bonded structure object M of a cross-section circle configuration as shown in drawing 4 (c) is obtained. By passing through this process, each pillar-shaped member 22a becomes the low heat-conduction member 22 which has a variant cross section. The above-mentioned paste 18 for sealant layers is applied to the whole field newly exposed by appearance cut. The periphery coat layer 16 is formed in the whole peripheral face of the filter bonded structure object M by this, and the ceramic filter aggregate 9 is completed.
[0049] Next, an operation of the above-mentioned ceramic filter aggregate 9 is explained briefly. Exhaust gas is supplied to the ceramic filter aggregate 9 held in casing 8 from the upstream end-face 9a side. The exhaust gas supplied through the 1st exhaust pipe 6 flows first in the cel which carries out opening in upstream end-face 9a. In this case, exhaust gas enters also into the cel of a honeycomb filter F1, and the cel of the low heat-conduction member 22. Subsequently, this exhaust gas passes a cell wall 13, and reaches the interior of the cel which adjoins it, i.e., the cel which carries out opening in downstream end-face 9b. And exhaust gas flows out of downstream end-face 9b through opening of this cel. However, the particle contained in exhaust gas will not be able to pass a cell wall 13, but a trap will be carried out there. Consequently, the purified exhaust gas is discharged from downstream end-face 9b. After the purified exhaust gas passes the 2nd exhaust pipe 7 further, it is eventually emitted into atmospheric air.
[0050] If a particle collects to some extent, the heater which is not illustrated will be turned on, the aggregate 9 will be heated and combustion clearance of the particle will be carried out. In the case of this kind of exhaust gas purge 1, the way of the core of the aggregate 9 becomes an elevated temperature previously on structure compared with the periphery section. That is, the way of the filter core member 21 becomes an elevated temperature previously compared with the low heat-conduction member 22. Therefore, heat moves to the low heat-conduction member 22 side which is a low temperature side from the filter core member 21 side which is an elevated-temperature side. However, the low heat-conduction member 22 is in contact with casing 8 through the heat insulator 10,

and heat tends to escape to the casing 8 side in the method of outside. With this operation gestalt, it is in the condition of being hard to heat-conduct the periphery section of the aggregate 9 compared with a core, by having arranged the low heat-conduction member 22. Therefore, as a result of the adiabatic efficiency in the periphery section of the aggregate 9 becoming high and heat's recess-coming to be hard from the peripheral face of the aggregate 9 to a casing 8 side, the temperature gradient in the aggregate 9 is canceled. Playback of the aggregate 9 is ensured from the above thing.

[0051] Next, the example and the example of a comparison which materialized this operation gestalt are introduced.

[0052]

[Working Example(s) and Comparative Example(s)] (Production of an example)

(1) Wet blending of 51.5 % of the weight of alpha mold silicon carbide powder and the 22 % of the weight of the beta mold silicon carbide powder was carried out, and into the obtained mixture, 6.5% of the weight, an organic binder (methyl cellulose) and water were added by a unit of 20% of the weight, and were kneaded, respectively. Next, the honeycomb-like generation form was acquired by carrying out extrusion molding of small quantity, in addition the thing kneaded further for a plasticizer and lubricant to said kneading object. Next, after drying this generation form using a microwave dryer, the breakthrough 12 of a Plastic solid was closed with the paste for closure made from a porosity silicon carbide sintered compact. Subsequently, the paste for closure was again dried using the dryer. After degreasing this desiccation object at 400 degrees C following an end-face closure process and carrying out temporary baking of it under the argon atmosphere of ordinary pressure further, actual baking was carried out at 2200 degrees C for about 3 hours. Consequently, the square pole-like honeycomb filter F1 (33mmx33mmx167mm) made from porosity silicon carbide was obtained. For the heat conductivity of the above-mentioned honeycomb filter F1, 73 W/m-K (RT), 30 W/m-K (500 degrees C), and Vickers hardness number were [50MPa(s) and the Young's modulus of 2000kg //mm / 2 or 3-point flexural strength] 48GPa(s).

[0053] And 0.5 % of the weight of carboxymethyl celluloses and 39 % of the weight of water as 7 % of the weight (the amount of conversions of SiO2 of a sol is 30%) of silica sols as 23.3 % of the weight of ceramic fiber, 30.2 % of the weight of silicon carbide powder of 0.3 micrometers of mean diameters, and an inorganic binder and an organic binder were mixed and kneaded. In addition, ceramic fiber is alumina silicate ceramic fiber with a% [of shot content] of 3, and a fiber length of 10 micrometers - 3000 micrometers. The paste 18 for sealant layers was produced by adjusting this kneading object to suitable viscosity. After applying such a paste 18 for sealant layers to the peripheral face of a honeycomb filter F1 at homogeneity, the peripheral faces of a honeycomb filter F1 were stuck mutually. The desired filter core member 21 was obtained by performing desiccation of 50 degrees C - 100 degree-Cx 1 hour in this condition, stiffening the nature sealant layer 15 of a ceramic, and unifying each honeycomb filter F1.

[0054] (2) After grinding and carrying out grain refining of the raw material which consists of a kaolin (15 % of the weight), an alumina (23 % of the weight), and talc (38 % of the weight), an organic binder (9 % of the weight) and water (15 % of the weight) were blended with this mixture, and it often kneaded. Next, the honeycomb-like generation form was acquired by carrying out extrusion molding of small quantity, in addition the thing kneaded further for a plasticizer and lubricant to said kneading object. Next, after drying this generation form using a microwave drier, the breakthrough 12 of a Plastic solid was closed with the paste for closure made from porosity cordierite. Subsequently, the paste for closure was again dried using the dryer. The end-face closure process was followed, conventionally, according to well-known conditions, it degreased and temporary-calcinated and actual baking of this desiccation object was carried out. Consequently, pillar-shaped member 22a made from square pole-like porosity cordierite (33mmx33mmx167mm) was obtained. For the heat conductivity of the above-mentioned pillar-shaped member 22a, 2 W/m-K (RT), 1 W/m-K (700 degrees C), and Vickers hardness number were [2.8MPa(s) and the Young's modulus of 1200kg //mm / 2 or 3 point flexural strength] 30GPa(s).

[0055] (3) Next, while applying the above-mentioned paste 18 for sealant layers to 12 peripheral faces of pillar-shaped member 22a, they have been arranged on the outside of the filter core member 21, and the peripheral face of each pillar-shaped member 22a was pasted up on the peripheral face of the filter core member 21 in this condition. Similarly, the peripheral faces of each pillar-shaped member 22a were pasted up at this time. Desiccation of 50 degrees C - 100 degree-Cx 1 hour was performed in this condition, the nature sealant layer 15 of a ceramic was stiffened, and the filter bonded structure object M which consists of a filter core member 21 and pillar-shaped member 22a was obtained.

(Appearance cut process) At the continuing appearance cut process, grinding of the filter bonded structure object M of the shape of a cross-section square pass the adhesion process was carried out, and the filter bonded structure object M of a cross-section circle configuration was produced as a whole. Then, said paste 18 for sealant layers was applied to the exposed whole peripheral face at homogeneity. And by drying and hardening on the conditions of 50 degrees C - 150 degree-Cx 1 hour, the periphery coat layer 16 with a thickness of 1.0mm was formed, and the ceramic filter aggregate 9 (diameter [of 135mm] x die length of 167mm) of an example was completed eventually. In addition, the grinding process was performed using the diamond cutter.

(Production of the example of a comparison) In the example of a comparison, the ceramic filter aggregate 9 of the same configuration and the same magnitude was fundamentally completed according to the production conditions of an example. However, all 16 honeycomb filters F1 made from a porosity silicon carbide sintered compact were used.

(The approach of an assessment trial, and result) The thermocouple was embedded at three places of the core (location shown by drawing 2 P1) of the aggregate 9, and the periphery section (location shown by drawing 2 P2 and P3). Then, what twisted the heat insulator 10 around the perimeter of the aggregate 9 was held in casing 8. Exhaust gas was actually supplied in this condition. Furthermore, while reproducing by heating a heater after predetermined time progress, the highest attainment temperature Ta, Tb, and Tc at the time of playback (degree C) was measured with said thermocouple, respectively. Those maximum temperature gradients (deltaT (degree C)) were searched for.

[0056] Consequently, in the example, maximum temperature-gradient deltaT is about at most 50 degrees C, and did not become so large a value, and breakage of the aggregate 9 by the thermal shock was not accepted, either. Moreover, when the aggregate 9 was removed, the aggregate 9 was cut along the direction of an axis after playback termination and macro-scopic observation of a cutting plane was performed, the cinder of soot was not accepted in a core and the periphery section. Therefore, it was proved by the example that efficient playback was performed.

[0057] On the other hand, in the example of a comparison, temperature-gradient deltaT is 100 degrees C, and became a quite large value compared with the example. Therefore, it was suggested that it is in the condition of being easy to damage the aggregate 9 by the thermal shock. Moreover, when macro-scopic observation of the cutting plane of the aggregate 9 was carried out after playback termination, the cinder of soot was accepted in the periphery section. Therefore, it was proved by the example of a comparison that efficient playback was not performed.

[0058] Moreover, the example of the time amount which the inclination for the rate of combustion of soot to become [the way of an example] quick is accepted, and playback so takes was also shorter. Therefore, according to this operation gestalt, the following effectiveness can be acquired.

[0059] (1) Like the above, by having arranged the low heat-conduction member 22, the adiabatic efficiency in the periphery section of

the aggregate 9 becomes high, and heat recess-comes to be hard to a casing 8 side from the peripheral face of the aggregate 9 with this operation gestalt. Consequently, it becomes easy to go up the temperature of the periphery section of the aggregate 9, and a temperature gradient with the core of the aggregate 9 becomes small. That is, when the aggregate 9 is heated by homogeneity, it is hard coming to generate big stress inside, and breakage of the aggregate 9 by the thermal shock can be prevented. Moreover, as a result of being able to attain uniform heating of the aggregate 9, the cinder of the soot in the periphery section of the aggregate 9 is canceled, and regeneration efficiency also improves certainly.

[0060] (2) In this ceramic filter aggregate 9, the ceramic porous body is used as a low heat-conduction member 22. A porous body has the advantage that specific surface area is large and itself functions as some filters. For this reason, even if not accompanied by enlargement of the filter core member 21, predetermined filtration capacity is maintainable. As [spoil / even if it carries out a long duration activity / moreover, / since a ceramic ingredient can generally also bear the temperature of exhaust gas with heat enough strongly / the thermal resistance of the aggregate 9]

[0061] (3) The low heat-conduction member 22 in this aggregate 9 is the honeycomb structure object with which the edge of the cel of a large number prolonged along the direction of an axis was closed by turns. Therefore, the filtration capacity of an aggregate 9 is certainly maintainable on high level by constituting an aggregate 9 using this. And buildup of pressure loss is avoidable.

[0062] (4) The low heat-conduction member 22 in this aggregate 9 is a product made from porosity cordierite. Not hard but the deer of porosity cordierite is as cheap as the ceramic porous body of the non-oxide system which uses silicon carbide as a principal component. And low-cost-izing of the low heat-conduction member 22 and manufacture easy-ization can be certainly attained by using a thing very suitable as a formation ingredient of such a low heat-conduction member 22.

[0063] (5) In this aggregate 9, the filter core member 21 and each low heat-conduction member 22 have pasted up mutually by the nature sealant layer 15 of a ceramic. Therefore, even if exposed to the heat of a case as it pasted up, for example using the usual resin system adhesives, a difference, and exhaust gas, high bond strength is maintainable. Therefore, it is also prevented that the seal nature in the interface concerned gets worse, without it seeming that a crack arises in the interface of the filter core member 21 and each low heat-conduction member 22.

[0064] (6) With this operation gestalt, after arranging pillar-shaped member 22a on the outside of the filter core member 21 and pasting up in the nature sealant layer 15 of a ceramic, the aggregate 9 is manufactured by removing a part of pillar-shaped member 22a, and preparing the whole appearance configuration. Since pillar-shaped member 22a used as the low heat-conduction member 22 consists of a ceramic ingredient with a low degree of hardness relatively, by cutting, it can remove the part without difficulty and can prepare the whole in a desired appearance configuration. Therefore, according to this manufacture approach, the aggregate 9 can be manufactured by low cost comparatively easily.

[The 2nd operation gestalt], next the operation gestalt 2 which materialized this invention are explained based on drawing 5 (a) - (c). Here, it only supposes that it is to mainly describe the point which is different from the operation gestalt 1, and to attach the same member number about a common point, and the explanation is omitted.

[0065] The aggregate 9 consists of these operation gestalten using two sorts of low heat-conduction members 22 and 23 from which thermal conductivity differs to the aggregate 9 having consisted of operation gestalten 1 using one sort of low heat-conduction members 22.

[0066] The 1st low heat-conduction member 22 consists of a ceramic ingredient with thermal conductivity lower than the ceramic porous body which constitutes the filter core member 21. The 1st low heat-conduction member 22 is pasted up on the peripheral face of the filter core member 21 through the nature sealant layer 15 of a ceramic in the condition of having been arranged at the side outside side of the filter core member 21. The aggregate 9 consists of these operation gestalten using the eight things same as 1st low heat-conduction member 22 as the "low heat-conduction member 22" indicated with the operation gestalt 1.

[0067] Rather than the ceramic ingredient which constitutes the 1st low heat-conduction member 22, the 2nd low heat-conduction member 23 consists of a ceramic ingredient with still lower thermal conductivity, and specifically consists of a ceramic ingredient of 0.01 W/m-K (RT) - 1 W/m-K. Moreover, as for the Vickers hardness number of the ceramic ingredient which constitutes the 2nd low heat-conduction member 23, three-point flexural strength, and Young's modulus, it is good that it is comparable as the operation gestalt 1.

[0068] The 2nd low heat-conduction member 23 is pasted up on the peripheral face of the 1st adjoining low heat-conduction member 22 through said nature sealant layer 15 of a ceramic while it is arranged on the corner outside of the filter core member 21. The aggregate 9 consists of these operation gestalten using the 2nd four low heat-conduction members 23.

[0069] Here, the chemical composition of the 2nd low heat-conduction member 23 may differ from the chemical composition of the 1st low heat-conduction member 22, and also may be equal. When a ceramic ingredient (this operation gestalt both porosity cordierite) of the same kind as the 1st low heat-conduction member 22 and 2nd low heat-conduction member 23 is chosen, the approaches of changing both thermal conductivity are enumerated below. For example, the porosity of the 1st low heat-conduction member 22 is set as a bigger value than that of the 2nd low heat-conduction member 23. The pore diameter of the 1st low heat-conduction member 22 is set as a bigger value than that of the 2nd low heat-conduction member 23. The consistency of the 1st low heat-conduction member 22 is set as a bigger value than that of the 2nd low heat-conduction member 23. The cell wall of the 1st low heat-conduction member 22 is set up more thickly than that of the 2nd low heat-conduction member 23.

[0070] Next, the manufacture approach of this aggregate 9 is explained. According to the procedure of the operation gestalt 1, eight honeycomb filters F1 are produced fundamentally, and these are pasted up and unified in the above-mentioned nature sealant layer 15 of a ceramic. Moreover, two or more two sorts of pillar-shaped members 22a and 23a from which thermal conductivity differs are produced every, respectively. In this case, in order to manufacture the one aggregate 9, thermal conductivity is [eight large pillar-shaped member 22a] relatively needed, and four small pillar-shaped member 23a is relatively needed for thermal conductivity (refer to drawing 5 (a)).

[0071] And while applying the above-mentioned paste 18 for sealant layers to the peripheral face of each pillar-shaped members 22a and 23a, pillar-shaped member 22a used as the 1st low heat-conduction member 22 is arranged to the side outside side of the filter core member 21. Moreover, pillar-shaped member 23a used as the 2nd low heat-conduction member 23 is arranged to the side outside side of the filter core member 21. The peripheral face of the filter core member 21 and the pillar-shaped members 22a and 23a is mutually pasted up through the nature sealant layer 15 of a ceramic in such the condition, and predetermined desiccation is performed. Consequently, the filter bonded structure object M as shown in drawing 5 (b) is obtained. Furthermore, the appearance cut of this filter bonded structure object M is carried out, and it considers as the ceramic filter aggregate 9 of a cross-section circle configuration.

[0072] Now, in the case of the aggregate 9 of the cross-section circle configuration shown in drawing 5 (c), the way of the corner outside part of the filter core member 21 is usually pressing hard compared with the side outside side part of the filter core member 21. That is, a heat transfer path becomes [the way of the corner outside part of the filter core member 21] short, and heat is recess and a cone from there to a casing 8 side. With this operation gestalt, the thermal conductivity of the corner outside part of the filter core

member 21 is still lower than the thermal conductivity of the side outside side part of the filter core member 21. Therefore, adiabatic efficiency can be raised more certainly. So, the ceramic filter aggregate 9 which was further excellent in reinforcement and regeneration efficiency is realizable.
[The 3rd operation gestalt], next the operation gestalt 3 which materialized this invention are explained based on drawing 6 (a) and (b). Here, it only supposes that it is to mainly describe the point which is different from the operation gestalt 1, and to attach the same member number about a common point, and the explanation is omitted.
[0073] In obtaining the almost same aggregate 9 as the operation gestalt 1 as a result, with this operation gestalt, the manufacture approach which is different in the operation gestalt 1 is enforced. Here, it is characterized by performing an appearance cut after an adhesion process, and performing the adhesion process, after producing beforehand the low heat-conduction members 24 and 25 of a request configuration rather than considering as the low heat-conduction member 22 of a request configuration. With this operation gestalt, two sorts of every two low heat-conduction members 24 and 25 from which the cross section and a cross-section configuration differ are prepared.
[0074] As for said low heat-conduction members 24 and 25 produced beforehand, one peripheral face is a convex curved surface. This convex curved surface constitutes a part of peripheral face of the aggregate 9 behind. The low heat-conduction members 24 and 25 consist of porosity cordierite with a ceramic ingredient with the heat conductivity lower than the ceramic porous body which constitutes the filter core member 21, and this operation gestalt.
[0075] At an adhesion process, while applying the above-mentioned paste 18 for sealant layers to fields other than the convex curved surface in the low heat-conduction members 24 and 25, where a convex curved surface is turned outside, the low heat-conduction members 24 and 25 are arranged. The peripheral face of the filter core member 21 and the low heat-conduction members 24 and 25 is mutually pasted up through the nature sealant layer 15 of a ceramic in such the condition, and predetermined desiccation is performed. Consequently, the ceramic filter aggregate 9 of a cross-section circle configuration as shown in drawing 6 (b) is obtained.
[0076] According to the manufacture approach of this operation gestalt, like the above, the ceramic filter aggregate 9 of a request configuration can be obtained, without passing through the appearance cut process by cutting. Therefore, the whole production process is simplified and only a part without an appearance cut process can manufacture the aggregate 9 by low cost comparatively easily. Moreover, since cut waste does not arise at the time of manufacture, there is also an advantage that there is also no fear of soiling a perimeter.
[0077] In addition, the operation gestalt of this invention may be changed as follows.
- It not only carries out a grinding process to a cross-section circle configuration, but you may carry out the grinding process of the whole aggregate 9 configuration, for example to configurations other than the following cross-section circle configurations according to an appearance cut process. The aggregate 9 formed in the shape of a cross-section abbreviation rice ball through the grinding process is shown in drawing 7 (c). The aggregate 9 formed through the grinding process in the shape of a cross-section abbreviation gold coin (the shape of a cross-section abbreviation truck) is shown in drawing 8 (c). Of course, the cross-section configuration of the aggregate 9 may be an abbreviation ellipse-like.
[0078] - The low heat-conduction member 22 does not necessarily need to be arranged so that the whole outside of the filter core member 21 may be surrounded thoroughly, and it may be arranged like example of another of drawing 8 (a) - (c) on outside [a part of].
[0079] - The cross-section configuration of the filter core member 21 may not be limited only in the shape of [like said each operation gestalt] a cross-section rectangle, for example, may be a non-rectangle-like (the shape of for example, an abbreviation cross joint) like example of another of drawing 8 (a) - (c).
[0080] - It may be arranged 1 round on the outside of the filter core member 21 (namely, only the outermost periphery arrangement), and also the low heat-conduction member 22 may be arranged 2 rounds or more.
- It is also possible to replace with a low heat-conduction member 22 made from a ceramic ingredient like each operation gestalt, for example, to adopt a metal (especially porosity metal) low heat-conduction member.
[0081] - As an ingredient of the low heat-conduction member 22, it is not limited only to the porous body which consists of an inorganic material, and the aggregate of an inorganic fiber etc. may be used.
- The pillar-shaped honeycomb filter F1 which constitutes the filter core member 21 may not be limited in the shape of a cross-section square, for example, may have the shape of the shape of a cross-section rectangle, and a cross-section hexagon etc.
[0082] Next, the technical thought grasped according to the operation gestalt mentioned above is enumerated below besides the technical thought indicated by the claim.
(1) The peripheral faces of two or more square pole-like honeycomb filters which consist of a porosity silicon carbide sintered compact by banding together through the nature sealant layer of a ceramic containing silicon carbide The edge of the filter core member which comes to unify said each honeycomb filter, and the cel of a large number prolonged along the direction of an axis consists of a pillar-shaped honeycomb structure object made from porosity cordierite closed by turns. The ceramic filter aggregate equipped with two or more low heat-conduction members which banded together through the nature sealant layer of a ceramic which contains silicon carbide in the peripheral face of this filter core member in the condition of having been arranged on the outside of said filter core member.
[0083]
[Effect of the Invention] As explained in full detail above, according to invention according to claim 1 to 7, the ceramic filter aggregate excellent in reinforcement and regeneration efficiency can be offered.
[0084] according to especially invention given in claims 5 and 6 -- manufacture -- the easy and comparatively cheap ceramic filter aggregate can be offered.

[Translation done.]

* NOTICES *

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3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The outline sectional view of the exhaust gas purge of the 1st operation gestalt which materialized this invention.
[Drawing 2] The front view of the ceramic filter aggregate used for the exhaust gas purge of the 1st operation gestalt.
[Drawing 3] The sectional view in the busy condition of the ceramic filter aggregate of the 1st operation gestalt.
[Drawing 4] (a) - (c) is a schematic diagram for explaining the manufacture procedure of the ceramic filter aggregate of the 1st operation gestalt.
[Drawing 5] (a) - (c) is a schematic diagram for explaining the manufacture procedure of the ceramic filter aggregate of the 2nd operation gestalt.
[Drawing 6] (a) and (b) are a schematic diagram for explaining the manufacture procedure of the ceramic filter aggregate of the 3rd operation gestalt.
[Drawing 7] (a) - (c) is a schematic diagram for explaining the manufacture procedure of the ceramic filter aggregate of example of another.
[Drawing 8] (a) - (c) is a schematic diagram for explaining the manufacture procedure of the ceramic filter aggregate of example of another.
[Description of Notations]
9 [-- A low heat-conduction member, 22a, 23a / -- A pillar-shaped member, F1 / -- Prismatic form honeycomb filter.] -- The ceramic filter aggregate, 15 -- The nature sealant layer of a ceramic, 21 -- A filter core member, 22, 23, 24, 25

[Translation done.]

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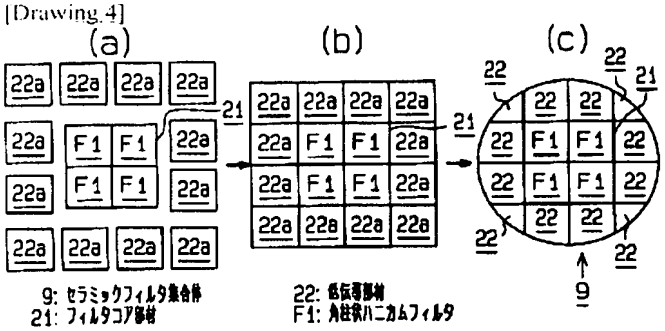
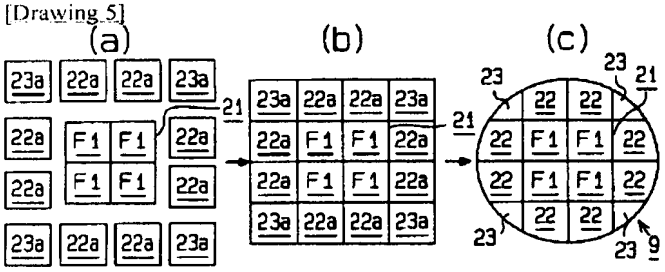
DRAWINGS

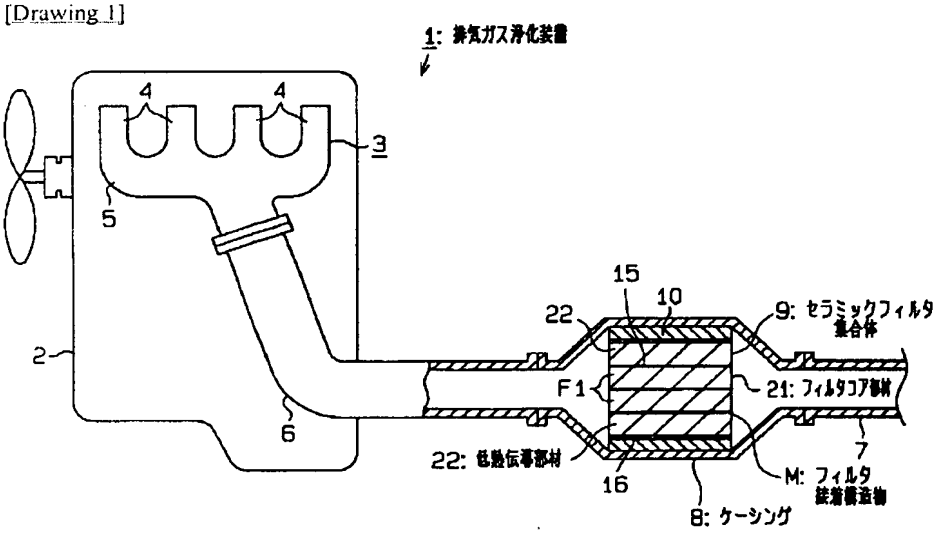
[Drawing 4]



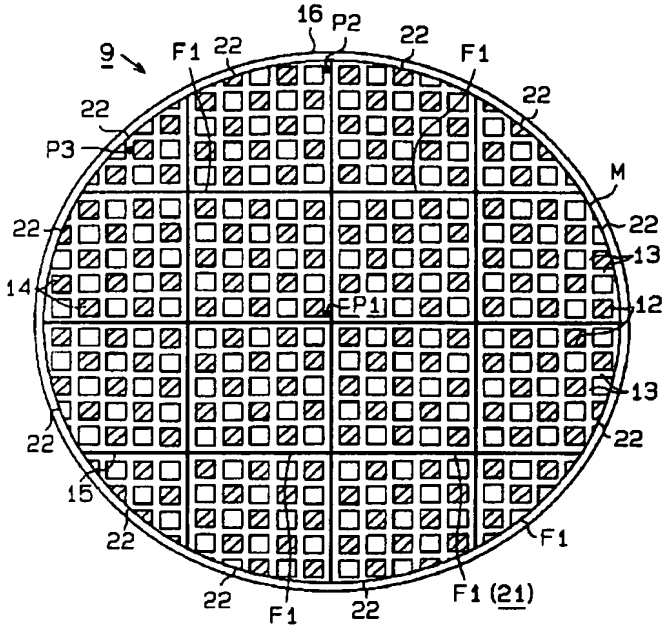
[Drawing 5]



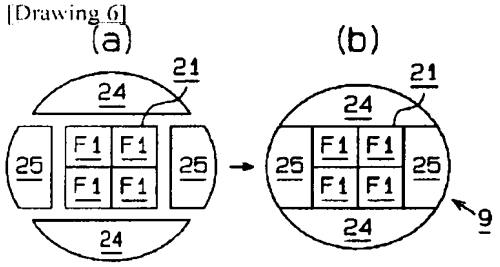
[Drawing 1]



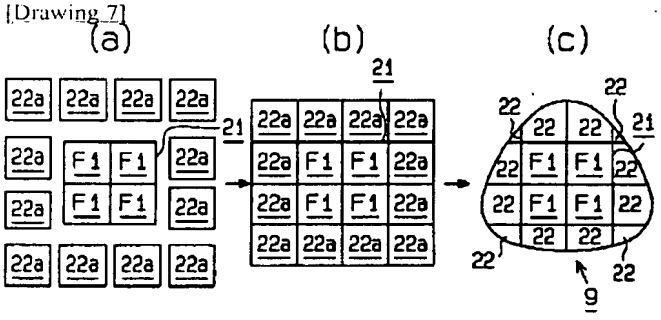
[Drawing 2]



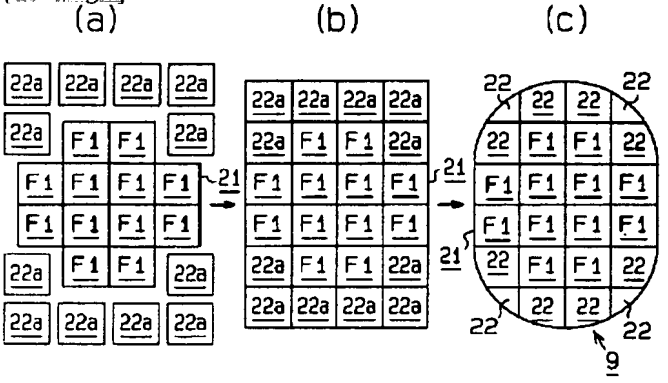
[Drawing 6]



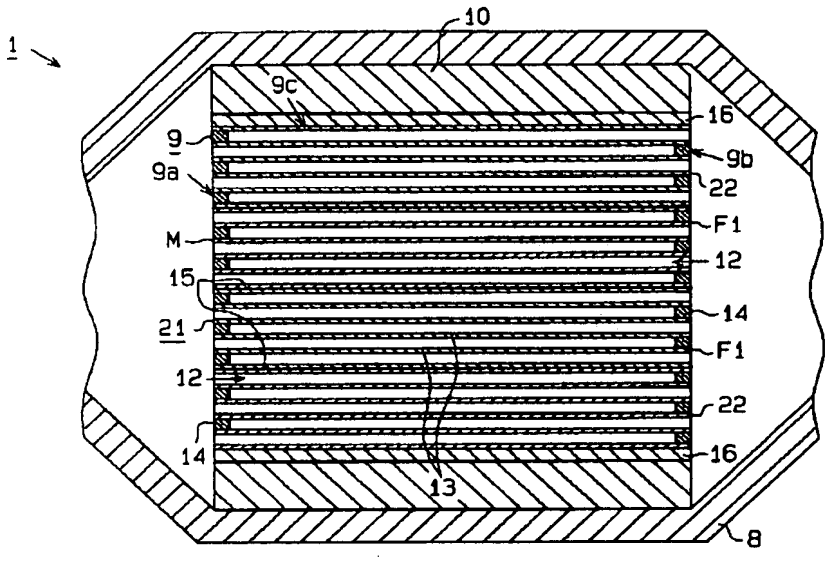
[Drawing 7]



[Drawing 8]



[Drawing 3]



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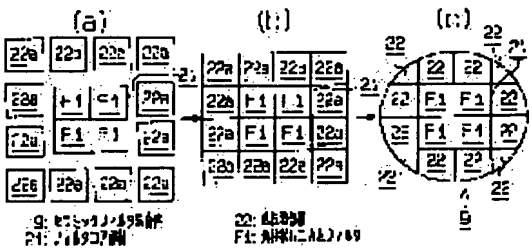
(71)Applicant : IBIDEN CO LTD
(72)Inventor : KUDO ATSUSHI

(54) CERAMIC FILTER ASSEMBLY

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a ceramic filter assembly having excellent strength and reproduction efficiency.
SOLUTION: The ceramic filter assembly 9 has filter core members 21 and low-thermal conductivity members 22. The members 21 are formed by bonding the outer peripheral surfaces of a plurality of prismatic honeycomb filters F1 to each other across ceramic sealing material layers. The prismatic honeycomb filters F1 consist of porous ceramic bodies of a non-oxide system essentially consisting of silicon carbide. The members 22 consist of ceramic materials having the lower thermal conductivity than the thermal conductivity of the porous ceramic bodies forming the members 21. The members 21 are bonded across the ceramic sealing material layers on the outer peripheral surfaces of the members 21 in the state of being arranged on the outer sides of the members 21.



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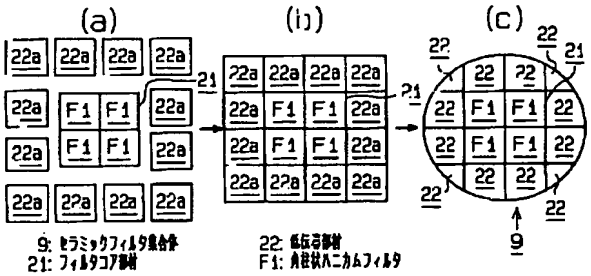
(54)【発明の名称】　セラミックフィルタ集合体

(57)【要約】
【課題】　強度及び再生効率に優れたセラミックフィルタ集合体を提供すること。
【解決手段】　本発明のセラミックフィルタ集合体９は、フィルタコア部材２１と低熱伝導部材２２とを備える。フィルタコア部材２１は、複数の角柱状ハニカムフィルタＦ１の外周面同士をセラミック質シール材層を介して接着したものである。角柱状ハニカムフィルタＦ１は、炭化珪素を主成分とする非酸化物系のセラミック多孔質体からなる。低熱伝導部材２２は、フィルタコア部材２１を構成するセラミック多孔質体よりも熱伝導率の低いセラミック材料からなる。低熱伝導部材２２は、フィルタコア部材２１の外側に配置された状態でフィルタコア部材２１の外周面にセラミック質シール材層を介して接着されている。



【特許請求の範囲】
【請求項１】炭化珪素を主成分とする非酸化物系のセラミック多孔質体からなる複数の柱状ハニカムフィルタの外周面同士をセラミック質シール材層を介して結束することにより、前記各ハニカムフィルタを一体化してなるフィルタコア部材と、
前記フィルタコア部材を構成するセラミック多孔質体よりも熱伝導率の低い材料からなり、前記フィルタコア部材の外側に配置された状態で同フィルタコア部材の外周面にセラミック質シール材層を介して結束された低熱伝導部材とを備えるセラミックフィルタ集合体。
【請求項２】炭化珪素を主成分とする非酸化物系のセラミック多孔質体からなる複数の柱状ハニカムフィルタの外周面同士をセラミック質シール材層を介して結束することにより、前記各ハニカムフィルタを角柱状に一体化してなるフィルタコア部材と、
前記フィルタコア部材を構成するセラミック多孔質体よりも熱伝導率の低いセラミック材料からなり、前記フィルタコア部材の辺部外側に配置された状態で同フィルタコア部材の外周面にセラミック質シール材層を介して結束された第１の低熱伝導部材と、
前記第１の低熱伝導部材を構成するセラミック材料よりもさらに熱伝導率の低いセラミック材料からなり、前記フィルタコア部材の角部外側に配置されるとともに、隣接する前記第１の低熱伝導部材の外周面にセラミック質シール材層を介して結束された第２の低熱伝導部材とを備えるセラミックフィルタ集合体。
【請求項３】前記低熱伝導部材はセラミック多孔質体であることを特徴とする請求項１または２に記載のセラミックフィルタ集合体。
【請求項４】前記低熱伝導部材は、軸線方向に沿って延びる多数のセルの端部が交互に封止されたハニカム構造体であることを特徴とする請求項３に記載のセラミックフィルタ集合体。
【請求項５】前記低熱伝導部材は、前記フィルタコア部材を構成するセラミック多孔質体よりも硬度の低いセラミック材料からなることを特徴とする請求項１乃至４のいずれか１項に記載のセラミックフィルタ集合体。
【請求項６】前記低熱伝導部材は、多孔質コーディエライト製であることを特徴とする請求項５に記載のセラミックフィルタ集合体。
【請求項７】前記セラミックフィルタ集合体は、断面円形状または断面楕円形状であることを特徴とする請求項１乃至６のいずれか一項に記載のセラミックフィルタ集合体。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、複数の柱状ハニカムフィルタをセラミック質シール材層を介して接着した部材を含んで構成されるセラミックフィルタ集合体に関するものである。
【０００２】
【従来の技術】自動車の台数は２０世紀以降飛躍的に増加しており、それに比例して自動車の内燃機関から出される排気ガスの量も急激な増加の一途を辿っている。特にディーゼルエンジンの出す排気ガス中に含まれる種々の物質は、汚染を引き起こす原因となるため、現在では世界環境にとって深刻な影響を与えつつある。また、最近では排気ガス中の微粒子（ディーゼルパティキュレート）が、ときとしてアレルギー障害や精子数の減少を引き起こす原因となるとの研究結果も報告されている。つまり、排気ガス中の微粒子を除去する対策を講じることが、人類にとって急務の課題であると考えられている。
【０００３】このような事情のもと、エンジンの排気マニホールドに連結された排気管の途上に金属製ケーシングを設け、その中にセラミックフィルタ集合体を配置した構造の排気ガス浄化装置が提案されている。セラミックフィルタ集合体とは、セラミック多孔質体からなる複数の角柱状ハニカムフィルタの外周面同士をセラミック質シール材層を介して接着・一体化してなるものをいう。ここで従来における集合体の製造方法を簡単に述べる。
【０００４】まず、押出成形機の金型を介してセラミック原料を連続的に押し出すことにより、四角柱状のハニカム成形体を形成する。ハニカム成形体を等しい長さに切断した後、その切断片を脱脂、焼成してハニカムフィルタとする。焼成工程の後、ハニカムフィルタの外周面にセラミック質シール材を均一に塗布し結束一体化する。そして、このようなフィルタ構造物の外周部分を研削加工することにより、断面円形状または断面楕円形状のセラミックフィルタ集合体が得られる。そして、上記集合体の外周面に断熱材を巻き付け、集合体を排気管の途上に設けられたケーシング内に収容することにより、最終的に排気ガス浄化装置が完成する。
【０００５】
【発明が解決しようとする課題】ところが、上記従来技術のセラミックフィルタ集合体の場合、集合体外周部からケーシング側に熱が逃げやすく、それゆえ集合体中心部に比べて集合体外周部のほうが低温になる傾向にある。よって、集合体内に温度差に起因する応力が発生し、ひいては熱衝撃により集合体が破損しやすくなる。また、温度が十分に上がりにくい集合体外周部においてはススの燃え残りが生じ、再生効率が悪くなるおそれがある。
【０００６】さらに、炭化珪素（ＳｉＣ）に代表される非酸化物系セラミック材料をフィルタ用材料として用いた場合、集合体全体の外形を整えるために、硬質なハニカムフィルタの一部を切削加工により除去する必要がある。それゆえ、製造が面倒であることに加え、コスト高になりやすいという問題がある。

【０００７】本発明は上記の課題に鑑みてなされたものであり、その第１の目的は、強度及び再生効率に優れたセラミックフィルタ集合体を提供することにある。本発明の第２の目的は、さらに、製造が容易であってかつ比較的安価なセラミックフィルタ集合体を提供することにある。

【０００８】

【課題を解決するための手段】上記の課題を解決するために、請求項１に記載の発明では、炭化珪素を主成分とする非酸化物系のセラミック多孔質体からなる複数の柱状ハニカムフィルタの外周面同士をセラミック質シール材層を介して結束することにより、前記各ハニカムフィルタを一体化してなるフィルタコア部材と、前記フィルタコア部材を構成するセラミック多孔質体よりも熱伝導率の低い材料からなり、前記フィルタコア部材の外側に配置された状態で同フィルタコア部材の外周面にセラミック質シール材層を介して結束された低熱伝導部材とを備えるセラミックフィルタ集合体をその要旨とする。

【０００９】請求項２に記載の発明では、炭化珪素を主成分とする非酸化物系のセラミック多孔質体からなる複数の柱状ハニカムフィルタの外周面同士をセラミック質シール材層を介して結束することにより、前記各ハニカムフィルタを角柱状に一体化してなるフィルタコア部材と、前記フィルタコア部材を構成するセラミック多孔質体よりも熱伝導率の低いセラミック材料からなり、前記フィルタコア部材の辺部外側に配置された状態で同フィルタコア部材の外周面にセラミック質シール材層を介して結束された第１の低熱伝導部材と、前記第１の低熱伝導部材を構成するセラミック材料よりもさらに熱伝導率の低いセラミック材料からなり、前記フィルタコア部材の角部外側に配置されるとともに、隣接する前記第１の低熱伝導部材の外周面にセラミック質シール材層を介して結束された第２の低熱伝導部材とを備えるセラミックフィルタ集合体をその要旨とする。

【００１０】請求項３に記載の発明は、請求項１または２において、前記低熱伝導部材はセラミック多孔質体であるとした。請求項４に記載の発明は、請求項３において、前記低熱伝導部材は、軸線方向に沿って延びる多数のセルの端部が交互に封止されたハニカム構造体であるとした。

【００１１】請求項５に記載の発明は、請求項１乃至４のいずれか１項において、前記低熱伝導部材は、前記フィルタコア部材を構成するセラミック多孔質体よりも硬度の低いセラミック材料からなるとした。

【００１２】請求項６に記載の発明は、請求項５において、前記低熱伝導部材は、多孔質コーディエライト製であるとした。請求項７に記載の発明は、請求項１乃至６のいずれか一項において、前記セラミックフィルタ集合体は、断面円形状または断面楕円形状であるとした。

【００１３】以下、本発明の「作用」について説明する。請求項１に記載の発明によると、低熱伝導部材を配置したことにより、集合体外周部における断熱効果が高くなり、集合体外周面からケーシング側に熱が逃げにくくなる。その結果、集合体外周部の温度が上がりやすくなり、集合体中心部との温度差が小さくなる。よって、大きな応力が発生しにくくなり、熱衝撃による集合体の破損が防止される。また、ススの燃え残りが生じにくくなり、再生効率も向上する。また、ススの燃え残りによるフィルタの限界を超えた異常な燃焼を抑えることができる。

【００１４】請求項２に記載の発明によると、請求項１に記載の作用に加えて下記の作用を奏する。フィルタコア部材の角部外側箇所のほうがフィルタコア部材の辺部外側箇所に比べて通常中央部から遠くなるため、温度が上がりにくく、ケーシング側に熱が逃げやすい。そこで、フィルタコア部材の角部外側箇所の熱伝導性を、フィルタコア部材の辺部外側箇所の熱伝導性よりもさらに低くしておくことにより、より確実に断熱効果を向上させることができる。

【００１５】請求項３に記載の発明によると、セラミック多孔質体からなる低熱伝導部材であれば、それ自身がフィルタの一部として機能するため、フィルタコア部材の大型化を伴わなくても所定の沪過能力が維持される。また、セラミック材料は一般的に熱に強いので、集合体の耐熱性が損なわれるようなこともなく、熱膨張率も同等なものが使用できる。

【００１６】請求項４に記載の発明によると、上記ハニカム構造体を低熱伝導部材として用いることにより、集合体の沪過能力を高いレベルに確実に維持することができる。

【００１７】請求項５に記載の発明によると、相対的に硬度の低いセラミック材料からなる低熱伝導部材であれば、集合体全体の外形を整えるために低熱伝導部材の一部を除去することが比較的容易になる。従って、製造がそれほど面倒でなく安価な集合体とすることができる。

【００１８】請求項６に記載の発明によると、多孔質コーディエライトは、炭化珪素を主成分とする非酸化物系のセラミック多孔質体ほど硬質ではなく、しかも廉価であるため、低熱伝導部材の形成材料として極めて好適である。

【００１９】

【発明の実施の形態】［第１の実施形態］以下、本発明を具体化した一実施形態のディーゼルエンジン用の排気ガス浄化装置１を、図１～図４（ｃ）に基づき詳細に説明する。

【００２０】図１に示されるように、この排気ガス浄化装置１は、内燃機関としてのディーゼルエンジン２から排出される排気ガスを浄化するための装置である。ディーゼルエンジン２は、図示しない複数の気筒を備えている。各気筒には、金属材料からなる排気マニホールド３

の分岐部4がそれぞれ連結されている。各分岐部4は1本のマニホールド本体5にそれぞれ接続されている。従って、各気筒から排出された排気ガスは一箇所に集中する。

【0021】排気マニホールド3の下流側には、金属材料からなる第1排気管6及び第2排気管7が配設されている。第1排気管6の上流側端は、マニホールド本体5に連結されている。第1排気管6と第2排気管7との間には、同じく金属材料からなる筒状のケーシング8が配設されている。ケーシング8の上流側端は第1排気管6の下流側端に連結され、ケーシング8の下流側端は第2排気管7の上流側端に連結されている。排気管6，7の途上にケーシング8が配設されていると把握することもできる。そして、この結果、第1排気管6、ケーシング8及び第2排気管7の内部領域が互いに連通し、その中を排気ガスが流れるようになっている。

【0022】図1に示されるように、ケーシング8はその中央部が排気管6，7よりも大径となるように形成されている。従って、ケーシング8の内部領域は、排気管6，7の内部領域に比べて広くなっている。このケーシング8内には、セラミックフィルタ集合体9が収容されている。

【0023】集合体9の外周面とケーシング8の内周面との間には、集合体9とは別体で構成された断熱材10が配設されている。断熱材10はセラミックファイバを含んで形成されたマット状物であり、その厚さは数mm～数十mmである。断熱材10は熱膨張性を有していることがよい。ここでいう熱膨張性とは、弾性構造を有するため熱応力を解放する機能があることを指す。その理由は、集合体9の最外周部から熱が逃げることを防止することにより、再生時のエネルギーロスを最小限に抑えるためである。また、弾性構造を有するので、排気ガスの圧力や走行による振動等のもたらすセラミックフィルタ集合体9の位置ずれを防止することができる。

【0024】本実施形態において用いられるセラミックフィルタ集合体9は、上記のごとくディーゼルパティキュレートを除去するものであるため、一般にディーゼルパティキュレートフィルタ（DPF）と呼ばれる。

【0025】このセラミックフィルタ集合体9は、フィルタコア部材21と、低熱伝導部材22とによって構成されている。フィルタコア部材21は集合体9の中心部に配置されている。フィルタコア部材21は、複数の柱状ハニカムフィルタF1を接着して一体化した構造を有している。本実施形態のハニカムフィルタF1では、軸線方向に対して直交する方向の断面がいずれも正方形状となっている。フィルタコア部材21自体の断面も正方形である。

【0026】図2，図3に示されるように、これらのフィルタF1は、いわゆるハニカム構造体である。ハニカム構造体を採用した理由は、微粒子の捕集量が増加したときでも圧力損失が小さいという利点があるからである。各ハニカムフィルタF1には、断面略正方形状をなす複数の貫通孔12がその軸線方向に沿って規則的に形成されている。各貫通孔12は薄いセル壁13によって互いに仕切られている。セルの内壁面には、白金族元素（例えばPt等）やその他の金属元素及びその酸化物等からなる酸化触媒が担持されている。

【0027】各貫通孔12の開口部は、いずれか一方の端面9a，9bの側において封止体14（ここでは多孔質炭化珪素焼結体）により封止されている。従って、端面9a，9b全体としてみると市松模様状を呈している。その結果、ハニカムフィルタF1には、断面四角形状をした多数のセルが形成されている。セルの密度は100～400個／平方インチ前後に設定され、セル壁13の厚さは0．05～0．5mm程度である。多数あるセルのうち、約半数のものは上流側端面9aにおいて開口し、残りのものは下流側端面9bにおいて開口している。

【0028】ハニカムフィルタF1の平均気孔径は1μm～50μmである。平均気孔径が1μm未満であると、微粒子の堆積によるハニカムフィルタF1の目詰まりが著しくなる。一方、平均気孔径が50μmを越えると、細かい微粒子を捕集することができなくなるため、捕集効率が著しく低下してしまう。

【0029】ハニカムフィルタF1の気孔率は30%～80%、さらには35%～70%であることが好ましい。気孔率が30%未満であると、ハニカムフィルタF1が緻密になりすぎてしまい、内部に排気ガスを流通させることができなくなるおそれがある。一方、気孔率が80%を越えると、ハニカムフィルタF1中に空隙が多くなりすぎてしまうため、強度的に弱くなりかつ微粒子の捕集効率が低下してしまうおそれがある。

【0030】図2，図3に示されるように、合計4個のハニカムフィルタF1の外周面は、セラミック質シール材層15を介して互いに接着されている。セラミック質シール材層15は、その組成中に無機バインダ、有機バインダ、無機繊維（具体的にはセラミックファイバ）を含有している。セラミックファイバを選択した理由は、セラミックファイバは耐熱性に優れているため、好適な耐熱性が付与されるからである。前記セラミックファイバとしては、例えば、シリカ－アルミナファイバ、ムライトファイバ、アルミナファイバ及びシリカファイバから選ばれる少なくとも1種以上のものが挙げられる。これらのなかでも、特にシリカ－アルミナファイバを選択することが望ましい。シリカ－アルミナファイバは、弾性に優れるとともに熱応力を吸収する作用を示すからである。なお、セラミック質シール材層15におけるファイバ含有量は固形分で10重量%～40重量%であることがよく、セラミックファイバの繊維長は10μm～3000μmであることがよい。セラミック質シール材層

１５の厚さは０．１ｍｍ～３ｍｍであることがよく、さらには０．３ｍｍ～１ｍｍであることがよい。

【００３１】一方、低熱伝導部材２２は、フィルタコア部材２１の外側に配置された状態で同フィルタコア部材２１の外周面にセラミック質シール材層１５を介して接着されている。なお、セラミック質シール材層１５の組成は、ハニカムフィルタＦ１間の接着に使用するものと同じでもよいほか、異なっていてもよい。本実施形態では同一のものを選択している。勿論、このようなセラミック質シール材層１５は、低熱伝導部材２２間の接着に使用されてもよい。

【００３２】上記角柱状ハニカムフィルタＦ１は、炭化珪素を主成分とする非酸化物系のセラミック多孔質体からなる。その理由は、このようなセラミック多孔質体は、他の非酸化物系セラミック多孔質体に比較して極めて耐熱性、機械的強度及び熱伝導性に優れているからである。「炭化珪素を主成分とする」とは、組成中に炭化珪素分を重量比で５０％以上含んでいることをいう。従って、組成中に炭化珪素分を重量比で５０％以上含み、かつそれよりも少量の他物質（例えば珪素や窒素等）を含むものも、炭化珪素を主成分とする非酸化物系のセラミック多孔質体に該当する。なお、本実施形態では、炭化珪素分を９９重量％以上含むセラミック多孔質体（高純度多孔質炭化珪素焼結体）が使用されている。

【００３３】上記低熱伝導部材２２は、フィルタコア部材２１を構成するセラミック多孔質体よりも熱伝導率の低いセラミック材料からなる。従って、高純度多孔質炭化珪素焼結体製のフィルタコア部材２１を用いた本実施形態では、低熱伝導部材２２は高純度多孔質炭化珪素焼結体よりも熱伝導率の低いセラミック材料からなる必要がある。

【００３４】低熱伝導部材２２は多孔質体、特にセラミック多孔質体であることがよい。好適なセラミック多孔質体の具体例としては、コーディエライト（$2MgO \cdot 2Al_2O_3 \cdot 5SiO_2$）、アルミナ（$Al_2O_3$）、ムライト（$3Al_2O_3 \cdot 2SiO_2$）等の多孔質体が挙げられる。とりわけ低熱伝導部材２２としては、酸化珪素を一成分として含む酸化物系のセラミック多孔質体からなることが好ましい。なお、低熱伝導部材２２は、軸線方向に沿って延びる多数のセルの端部が交互に封止されたハニカム構造体であることがよい。

【００３５】セラミック多孔質体からなる低熱伝導部材２２であれば、それ自身がフィルタの一部として機能するため、フィルタコア部材２１の大型化を伴わなくても所定の沪過能力が維持されるからである。また、セラミック材料は一般的に熱に強いので、これを用いれば集合体９の好適な耐熱性が維持されるからである。なお、前記ハニカム構造体のセル壁には、ハニカムフィルタＦ１と同じように酸化触媒が担持されていることがよい。

【００３６】また、上記低熱伝導部材２２は、フィルタコア部材２１を構成するセラミック多孔質体（ここでは高純度多孔質炭化珪素焼結体）よりも硬度の低いセラミック材料からなることが望ましい。その理由は、高純度多孔質炭化珪素焼結体に比べて相対的に硬度が低ければ、容易に外形カット工程を行うことが可能だからである。以上のことから、本実施形態では多孔質コーディエライト製の低熱伝導部材２２を用いている。即ち、多孔質コーディエライトは、炭化珪素を主成分とする非酸化物系のセラミック多孔質体ほど高熱伝導性・硬質ではなく、しかも廉価であるため、低熱伝導部材２２の形成材料として極めて好適だからである。また、多孔質ハニカム構造体を容易に作製することが可能だからである。

【００３７】ここで、フィルタコア部材２１を構成するセラミック多孔質体の５００℃での熱伝導率は１Ｗ／ｍ・Ｋ～２００Ｗ／ｍ・Ｋであることがよく、低熱伝導部材２２を構成するセラミック材料の熱伝導率はフィルタコア部材２１を構成するセラミック多孔質体より低くする方がよい。

【００３８】フィルタコア部材２１を構成するセラミック多孔質体の熱伝導率が小さすぎると、フィルタコア部材２１内に温度差が生じやすくなり、クラックの原因となる熱応力の発生につながるおそれがある。フィルタコア部材２１を構成するセラミック多孔質体の熱伝導率を大きくしようとすると、材料の選定や焼成条件の設定等が難しくなり、製造コストの高騰をきたすおそれがある。低熱伝導部材２２を構成するセラミック材料の熱伝導率が大きすぎると、集合体９の外周部における断熱効果を十分に高めることができなくなる。よって、集合体９の外周面からケーシング８側に逃げてしまう熱量を効果的に低減できなくなる。

【００３９】フィルタコア部材２１を構成するセラミック多孔質体のビッカース硬さは１５００～３０００ｋｇ／mm^2であることがよく、低熱伝導部材２２を構成するセラミック材料のビッカース硬さはフィルタコア部材２１を構成するセラミック多孔質体より相対的に低くする方がよい。

【００４０】フィルタコア部材２１を構成するセラミック多孔質体が柔らかすぎると、フィルタコア部材２１の強度低下、ひいては集合体９全体の強度低下を来してしまい、耐久性に劣る集合体９となってしまう。フィルタコア部材２１を構成するセラミック多孔質体を上記値よりも硬くしようとすると、材料の選定や焼成条件の設定等が難しくなり、製造コストの高騰をきたすおそれがある。低熱伝導部材２２を構成するセラミック材料が柔らかすぎると、製造時に研削加工しやすい利点がある反面、使用時に割れ等が発生しやすくなる。よって、集合体９全体の強度低下につながるおそれがある。

【００４１】完成した集合体９において低熱伝導部材２２の断面形状は、フィルタコア部材２１を構成する各ハニカムフィルタＦ１とは違う形状、即ち異型の柱状部材

となっている。低熱伝導部材２２における１つの外周面は、研削加工により除去されることによってできた凸状曲面になっている。この凸状曲面は、集合体９の外周面の一部を構成する。なお、これら低熱伝導部材２２は、製造初期の段階においては各ハニカムフィルタＦ１と同様の断面形状を呈している。１つの集合体９に用いられている低熱伝導部材２２の数は１２本であり、それらがフィルタコア部材２１の外側を完全に包囲した状態になっている。そして、集合体９全体としてみると、円柱状のセラミックフィルタ集合体９（直径１３５ｍｍ前後）が構成されている。

【００４２】次に、上記のセラミックフィルタ集合体９を製造する手順を図４（ａ）～（ｃ）に基づいて説明する。まず、押出成形時に使用するセラミック原料スラリー、端面封止のために用いる封止用ペースト、接着工程で使用するシール材層用ペースト１８をあらかじめ作製しておく。セラミック原料スラリーについては、フィルタコア部材２１用及び低熱伝導部材２２用の２種を用意する。

（フィルタコア部材２１用のハニカムフィルタＦ１の作製）ハニカムフィルタＦ１形成用のセラミック原料スラリーとしては、炭化珪素粉末に有機バインダ及び水を所定分量ずつ配合し、かつ混練したものを用いる。封止用ペーストとしては、炭化珪素粉末に有機バインダ、潤滑剤、可塑剤及び水を配合し、かつ混練したものを用いる。シール材層用ペースト１８としては、無機繊維、無機バインダ、有機バインダ、無機粒子及び水を所定分量ずつ配合し、かつ混練したものを用いる。

【００４３】次に、前記セラミック原料スラリーを押出成形機に投入し、金型を介してそれを連続的に押し出す。その後、押出成形されたハニカム成形体を等しい長さに切断し、四角柱状のハニカム成形体切断片を得る。さらに、切断片の各セルの片側開口部に所定量ずつ封止用ペーストを充填し、各切断片の両端面を封止する。

【００４４】続いて、温度・時間等を所定の条件に設定して脱脂、焼成を行い、ハニカム成形体切断片及び封止体１４を完全に焼結させ、四角柱状の多孔質炭化珪素焼結体製のハニカムフィルタＦ１を４個得る。

【００４５】なお、平均気孔径を６μｍ～１５μｍとしかつ気孔率を３５％～５０％とするために、本実施形態では焼成温度を２１００℃～２３００℃に設定し、焼成時間を０．１時間～５時間に設定している。また、焼成時の炉内雰囲気を不活性雰囲気とし、そのときの雰囲気の圧力を常圧としている。

【００４６】次に、必要に応じてハニカムフィルタＦ１の外周面にセラミック質からなる下地層を形成した後、さらにその上にシール材層用ペースト１８を塗布する。そして、４個のハニカムフィルタＦ１の外周面同士を接着して一体化することにより、断面正方形状のフィルタコア部材２１を得る。

（低熱伝導部材２２の作製）低熱伝導部材２２形成用のセラミック原料スラリーとしては、カオリン、アルミナ、タルクからなる原料を粉砕して粒度調整した後、有機バインダ及び水を所定分量ずつ配合し、かつ混練したものを用いる。封止用ペーストとしては、カオリン、アルミナ、タルクからなる原料を粉砕して粒度調整したものに有機バインダ、潤滑剤、可塑剤及び水を配合し、かつ混練したものを用いる。シール材層用ペースト１８としては上記のものを流用する。

【００４７】次に、前記セラミック原料スラリーを押出成形機に投入し、金型を介してそれを連続的に押し出す。その後、押出成形されたハニカム成形体を等しい長さに切断し、四角柱状のハニカム成形体切断片を得る。さらに、切断片の各セルの片側開口部に所定量ずつ封止用ペーストを充填し、各切断片の両端面を封止する。

【００４８】続いて、温度・時間等を従来公知の条件に設定して脱脂、焼成を行い、ハニカム成形体切断片及び封止体１４を完全に焼結させ角柱状の多孔質コーディエライト焼結体製の柱状部材２２ａを得る。

（接着工程）次に、必要に応じて柱状部材２２ａの外周面にもセラミック質からなる下地層を形成した後、さらにその上にシール材層用ペースト１８を塗布する。そして、１２個の柱状部材２２ａをフィルタコア部材２１の外側に配置し、この状態で各柱状部材２２ａの外周面をフィルタコア部材２１の外周面に接着する。その結果、フィルタコア部材２１と柱状部材２２ａとからなるフィルタ接着構造物Ｍが得られる。図４（ａ），（ｂ）に示されるように、この時点ではフィルタ接着構造物Ｍはまだ全体として断面正方形状を呈している。

（外形カット工程）続く外形カット工程では、接着工程を経て得られた断面正方形状のフィルタ接着構造物Ｍを研削し、外周部における不要部分を除去してその外形を整える。具体的には、フィルタコア部材２１の外周全体を包囲するようにして配置されている各柱状部材２２ａの一部を曲面的に研削して除去する。その結果、図４（ｃ）に示されるような断面円形状のフィルタ接着構造物Ｍが得られる。この工程を経ることにより、各柱状部材２２ａは異型断面を有する低熱伝導部材２２となる。外形カットによって新たに露出した面の全体には、上記シール材層用ペースト１８が塗布される。これによりフィルタ接着構造物Ｍの外周面全体に外周コート層１６が形成され、セラミックフィルタ集合体９が完成する。

【００４９】次に、上記のセラミックフィルタ集合体９の作用について簡単に説明する。ケーシング８内に収容されたセラミックフィルタ集合体９には、上流側端面９ａの側から排気ガスが供給される。第１排気管６を経て供給されてくる排気ガスは、まず、上流側端面９ａにおいて開口するセル内に流入する。この場合、排気ガスは、ハニカムフィルタＦ１のセルにも、低熱伝導部材２２のセルにも入り込む。次いで、この排気ガスはセル壁

１３を通過し、それに隣接しているセル、即ち下流側端面９ｂにおいて開口するセルの内部に到る。そして、排気ガスは、同セルの開口を介して下流側端面９ｂから流出する。しかし、排気ガス中に含まれる微粒子はセル壁１３を通過することができず、そこにトラップされてしまう。その結果、浄化された排気ガスが下流側端面９ｂから排出される。浄化された排気ガスは、さらに第２排気管７を通過した後、最終的には大気中へと放出される。

【００５０】ある程度微粒子が溜まってきたら、図示しないヒータをオンして集合体９を加熱し、微粒子を燃焼除去させる。この種の排気ガス浄化装置１の場合、構造上、集合体９の中心部のほうが外周部に比べて先に高温になる。即ち、フィルタコア部材２１のほうが低熱伝導部材２２に比べて先に高温になる。従って、熱は、高温側であるフィルタコア部材２１側から、低温側である低熱伝導部材２２側へと移動する。しかし、低熱伝導部材２２は断熱材１０を介してケーシング８に接しており、熱は外方にあるケーシング８側に逃げようとする。本実施形態では、低熱伝導部材２２を配置したことにより、集合体９の外周部が中心部に比べて熱伝導しにくい状態になっている。よって、集合体９の外周部における断熱効果が高くなり、集合体９の外周面からケーシング８側に熱が逃げにくくなる結果、集合体９内の温度差が解消される。以上のことから、集合体９の再生が確実に行われる。

【００５１】次に、本実施形態を具体化した実施例及び比較例を紹介する。

【００５２】

【実施例及び比較例】（実施例の作製）

（１）α型炭化珪素粉末５１．５重量％とβ型炭化珪素粉末２２重量％とを湿式混合し、得られた混合物に有機バインダ（メチルセルロース）と水とをそれぞれ６．５重量％、２０重量％ずつ加えて混練した。次に、前記混練物に可塑剤と潤滑剤とを少量加えてさらに混練したものを押出成形することにより、ハニカム状の生成形体を得た。次に、この生成形体をマイクロ波乾燥機を用いて乾燥した後、成形体の貫通孔１２を多孔質炭化珪素焼結体製の封止用ペーストによって封止した。次いで、再び乾燥機を用いて封止用ペーストを乾燥させた。端面封止工程に続いて、この乾燥体を４００℃で脱脂した後、さらにそれを常圧のアルゴン雰囲気下において仮焼成した後、２２００℃で約3時間本焼成した。その結果、四角柱状の多孔質炭化珪素製ハニカムフィルタＦ１（３３ｍｍ×３３ｍｍ×１６７ｍｍ）を得た。上記ハニカムフィルタＦ１の熱伝導率は７３Ｗ／ｍ・Ｋ（ＲＴ），３０Ｗ／ｍ・Ｋ（５００℃）、ビッカース硬さは２０００ｋｇ／ｍｍ²、３点曲げ強度は５０ＭＰａ、ヤング率は４８ＧＰａであった。

【００５３】そして、セラミックファイバ２３．３重量％、平均粒径０．３μｍの炭化珪素粉末３０．２重量％、無機バインダとしてのシリカゾル（ゾルのＳｉO_2の換算量は３０％）７重量％、有機バインダとしてのカルボキシメチルセルロース０．５重量％及び水３９重量％を混合・混練した。なお、セラミックファイバとは、ショット含有率３％、繊維長さ１０μｍ～３０００μｍのアルミナシリケートセラミックファイバである。この混練物を適当な粘度に調整することにより、シール材層用ペースト１８を作製した。このようなシール材層用ペースト１８をハニカムフィルタＦ１の外周面に均一に塗布した後、ハニカムフィルタＦ１の外周面同士を互いに密着させた。この状態で５０℃～１００℃×１時間の乾燥を行ってセラミック質シール材層１５を硬化させ、各ハニカムフィルタＦ１を一体化することにより、所望のフィルタコア部材２１を得た。

【００５４】（２）カオリン（１５重量％）、アルミナ（２３重量％）、タルク（３８重量％）からなる原料を粉砕して粒度調整した後、この混合物に有機バインダ（９重量％）及び水（１５重量％）を配合し、よく混練した。次に、前記混練物に可塑剤と潤滑剤とを少量加えてさらに混練したものを押出成形することにより、ハニカム状の生成形体を得た。次に、この生成形体をマイクロ波乾燥機を用いて乾燥した後、成形体の貫通孔１２を多孔質コーディエライト製の封止用ペーストによって封止した。次いで、再び乾燥機を用いて封止用ペーストを乾燥させた。端面封止工程に続いて、この乾燥体を従来公知の条件により脱脂、仮焼成、本焼成した。その結果、四角柱状の多孔質コーディエライト製の柱状部材２２ａ（３３ｍｍ×３３ｍｍ×１６７ｍｍ）を得た。上記柱状部材２２ａの熱伝導率は２Ｗ／ｍ・Ｋ（ＲＴ），１Ｗ／ｍ・Ｋ（７００℃）、ビッカース硬さは１２００ｋｇ／ｍｍ²、３点曲げ強度は２．８ＭＰａ、ヤング率は３０ＧＰａであった。

【００５５】（３）次に、１２個の柱状部材２２ａの外周面に上記シール材層用ペースト１８を塗布するとともに、それらをフィルタコア部材２１の外側に配置し、この状態で各柱状部材２２ａの外周面をフィルタコア部材２１の外周面に接着した。同様に、このとき各柱状部材２２ａの外周面同士も接着した。この状態で５０℃～１００℃×１時間の乾燥を行ってセラミック質シール材層１５を硬化させ、フィルタコア部材２１と柱状部材２２ａとからなるフィルタ接着構造物Ｍを得た。

（外形カット工程）続く外形カット工程では、接着工程を経て得られた断面正方形状のフィルタ接着構造物Ｍを研削し、全体として断面円形状のフィルタ接着構造物Ｍを作製した。その後、露出した外周面全体に前記シール材層用ペースト１８を均一に塗布した。そして、５０℃～１５０℃×１時間の条件で乾燥・硬化することにより厚さ１．０ｍｍの外周コート層１６を形成し、最終的に実施例のセラミックフィルタ集合体９（直径１３５ｍｍ

×長さ１６７ｍｍ）を完成させた。なお、研削加工はダイヤモンドカッターを用いて行った。

（比較例の作製）比較例では、基本的に実施例の作製条件に従って、同じ形状かつ同じ大きさのセラミックフィルタ集合体９を完成させた。ただし、１６個とも多孔質炭化珪素焼結体製のハニカムフィルタＦ１を用いた。

（評価試験の方法及び結果）集合体９の中心部（図２にてＰ１で示される位置）及び外周部（図２にてＰ２，Ｐ３で示される位置）の３ヶ所に熱電対を埋め込んだ。この後、集合体９の周囲に断熱材１０を巻き付けたものを、ケーシング８内に収容した。この状態で実際に排気ガスを供給した。さらに、所定時間経過後にヒータを加熱して再生を行うとともに、前記熱電対によって再生時の最高到達温度Ｔａ，Ｔｂ，Ｔｃ（℃）をそれぞれ測定した。それらの最大温度差（ΔＴ（℃））を求めた。

【００５６】その結果、実施例では、最大温度差ΔＴはせいぜい５０℃程度であってそれほど大きい値にはならず、熱衝撃による集合体９の破損も認められなかった。また、再生終了後に集合体９を取り外して集合体９を軸線方向に沿って切断し、切断面の肉眼観察を行ったところ、中心部にも外周部にもススの燃え残りは認められなかった。ゆえに、実施例では効率のよい再生が行われていたことが実証された。

【００５７】これに対して比較例では、温度差ΔＴが１００℃であって実施例に比べてかなり大きい値となった。ゆえに、熱衝撃により集合体９が破損しやすい状態にあることが示唆された。また、再生終了後に集合体９の切断面を肉眼観察したところ、外周部にススの燃え残りが認められた。ゆえに、比較例では効率のよい再生が行われていなかったことが実証された。

【００５８】また、実施例のほうがススの燃焼速度が速くなる傾向が認められ、それゆえ再生に要する時間も実施例のほうが短かった。従って、本実施形態によれば以下のような効果を得ることができる。

【００５９】（１）本実施形態では、上記のごとく低熱伝導部材２２を配置したことにより、集合体９の外周部における断熱効果が高くなり、集合体９の外周面からケーシング８側に熱が逃げにくくなる。その結果、集合体９の外周部の温度が上がりやすくなり、集合体９の中心部との温度差が小さくなる。つまり、集合体９が均一に加熱されることにより、内部に大きな応力が発生しにくくなり、熱衝撃による集合体９の破損を防止することができる。また、集合体９の均一な加熱が達成できる結果、集合体９の外周部におけるススの燃え残りが解消され、再生効率も確実に向上する。

【００６０】（２）このセラミックフィルタ集合体９では、低熱伝導部材２２としてセラミック多孔質体が用いられている。多孔質体は比表面積が大きく、それ自身がフィルタの一部として機能するという利点がある。このため、フィルタコア部材２１の大型化を伴わなくても所定の沪過能力を維持することができる。また、セラミック材料は一般的に熱に強く排気ガスの温度にも十分耐え得るので、長時間使用したとしても集合体９の耐熱性が損なわれるようなことはない。

【００６１】（３）この集合体９における低熱伝導部材２２は、軸線方向に沿って延びる多数のセルの端部が交互に封止されたハニカム構造体である。従って、これを用いて集合体９を構成することにより、集合体９の沪過能力を高いレベルに確実に維持することができる。しかも、圧力損失の増大を回避することができる。

【００６２】（４）この集合体９における低熱伝導部材２２は、多孔質コーディエライト製である。多孔質コーディエライトは、炭化珪素を主成分とする非酸化物系のセラミック多孔質体ほど硬質ではなく、しかも廉価である。そして、このような低熱伝導部材２２の形成材料として極めて好適なものを用いることにより、低熱伝導部材２２の低コスト化及び製造容易化を確実に達成することができる。

【００６３】（５）この集合体９では、フィルタコア部材２１と各低熱伝導部材２２とがセラミック質シール材層１５により互いに接着されている。従って、例えば通常の樹脂系接着剤を用いて接着したような場合とな異なり、排気ガスの熱に晒されたとしても高い接着強度を維持することができる。よって、フィルタコア部材２１と各低熱伝導部材２２との界面にクラックが生じるようなこともなく、当該界面におけるシール性が悪化するといったことも防止される。

【００６４】（６）本実施形態では、柱状部材２２ａをフィルタコア部材２１の外側に配置してセラミック質シール材層１５にて接着した後、柱状部材２２ａの一部を除去して全体の外形形状を整えることにより、集合体９を製造している。低熱伝導部材２２となる柱状部材２２ａは、相対的に硬度の低いセラミック材料からなるため、切削加工によってその一部を困難なく除去することができ、全体を所望の外形形状に整えることができる。よって、この製造方法によれば、比較的容易にかつ低コストで集合体９を製造することができる。

［第２の実施形態］次に、本発明を具体化した実施形態２を図５（ａ）～（ｃ）に基づいて説明する。ここでは実施形態１と相違する点を主に述べ、共通する点については同一部材番号を付すのみとしてその説明を省略する。

【００６５】実施形態１では１種の低熱伝導部材２２を用いて集合体９が構成されていたのに対し、本実施形態では熱伝導性の異なる２種の低熱伝導部材２２，２３を用いて集合体９が構成されている。

【００６６】第１の低熱伝導部材２２は、フィルタコア部材２１を構成するセラミック多孔質体よりも熱伝導率の低いセラミック材料からなる。第１の低熱伝導部材２２は、フィルタコア部材２１の辺部外側に配置された状

態でフィルタコア部材２１の外周面にセラミック質シール材層１５を介して接着されている。本実施形態では、第１の低熱伝導部材２２として、実施形態１にて記載した「低熱伝導部材２２」と同じものを８個用い、集合体９を構成している。

【００６７】第２の低熱伝導部材２３は、第１の低熱伝導部材２２を構成するセラミック材料よりもさらに熱伝導率の低いセラミック材料からなり、具体的には０．０１W／m・K（RT）～１W／m・Kのセラミック材料からなる。また、第２の低熱伝導部材２３を構成するセラミック材料のビッカース硬さ、３点曲げ強度、ヤング率は実施形態１と同程度であることがよい。

【００６８】第２の低熱伝導部材２３は、フィルタコア部材２１の角部外側に配置されるとともに、隣接する第１の低熱伝導部材２２の外周面に前記セラミック質シール材層１５を介して接着されている。本実施形態では、第２の低熱伝導部材２３を４個用いて集合体９が構成されている。

【００６９】ここで、第２の低熱伝導部材２３の化学組成は、第１の低熱伝導部材２２の化学組成と異なっていてもよいほか、等しくてもよい。第１の低熱伝導部材２２及び第２の低熱伝導部材２３として同種のセラミック材料（本実施形態ではともに多孔質コーディエライト）を選択した場合に、両者の熱伝導率を異ならせる方法を以下に列挙する。例えば、第１の低熱伝導部材２２の気孔率を、第２の低熱伝導部材２３のそれよりも大きな値に設定する。第１の低熱伝導部材２２の気孔径を、第２の低熱伝導部材２３のそれよりも大きな値に設定する。第１の低熱伝導部材２２の密度を、第２の低熱伝導部材２３のそれよりも大きな値に設定する。第１の低熱伝導部材２２のセル壁を、第２の低熱伝導部材２３のそれよりも厚く設定する。

【００７０】次にこの集合体９の製造方法を説明する。基本的には実施形態１の手順に従ってハニカムフィルタＦ１を８個作製し、これらを上記セラミック質シール材層１５にて接着・一体化しておく。また、熱伝導率の異なる二種の柱状部材２２ａ，２３ａをそれぞれ複数個ずつ作製しておく。この場合、１つの集合体９を製造するためには、熱伝導率が相対的に大きい柱状部材２２ａが８個必要になり、熱伝導率が相対的に小さい柱状部材２３ａが４個必要になる（図５（ａ）参照）。

【００７１】そして、各柱状部材２２ａ，２３ａの外周面に上記シール材層用ペースト１８を塗布するとともに、第１の低熱伝導部材２２となる柱状部材２２ａをフィルタコア部材２１の辺部外側に配置する。また、第２の低熱伝導部材２３となる柱状部材２３ａをフィルタコア部材２１の辺部外側に配置する。このような状態でフィルタコア部材２１、柱状部材２２ａ，２３ａの外周面を互いにセラミック質シール材層１５を介して接着し、所定の乾燥を行う。その結果、図５（ｂ）に示すようなフィルタ接着構造物Ｍを得る。さらに、このフィルタ接着構造物Ｍを外形カットして、断面円形状のセラミックフィルタ集合体９とする。

【００７２】さて、図５（ｃ）に示す断面円形状の集合体９の場合、フィルタコア部材２１の角部外側箇所のほうがフィルタコア部材２１の辺部外側箇所に比べて通常肉薄になる。つまり、フィルタコア部材２１の角部外側箇所のほうが熱伝達経路が短くなり、そこからケーシング８側に熱が逃げやすい。本実施形態では、フィルタコア部材２１の角部外側箇所の熱伝導性が、フィルタコア部材２１の辺部外側箇所の熱伝導性よりもさらに低くなっている。従って、より確実に断熱効果を向上させることができる。それゆえ、強度及び再生効率にいっそう優れたセラミックフィルタ集合体９を実現することができる。

［第３の実施形態］次に、本発明を具体化した実施形態３を図６（ａ），（ｂ）に基づいて説明する。ここでは実施形態１と相違する点を主に述べ、共通する点については同一部材番号を付すのみとしてその説明を省略する。

【００７３】本実施形態では結果的に実施形態１とほぼ同様の集合体９を得るにあたり、実施形態１とは異なる製造方法を実施している。ここでは、接着工程後に外形カットを行って所望形状の低熱伝導部材２２とするのではなく、所望形状の低熱伝導部材２４，２５をあらかじめ作製したうえでその接着工程を行うことを特徴とする。本実施形態では、断面積及び断面形状の異なる２種の低熱伝導部材２４，２５を２つずつ用意している。

【００７４】あらかじめ作製される前記低熱伝導部材２４，２５は、１つの外周面が凸状曲面になっている。この凸状曲面は、後に集合体９の外周面の一部を構成するものである。低熱伝導部材２４，２５は、フィルタコア部材２１を構成するセラミック多孔質体よりも熱伝導率の低いセラミック材料、本実施形態では多孔質コーディエライトからなる。

【００７５】接着工程では、低熱伝導部材２４，２５における凸状曲面以外の面に上記シール材層用ペースト１８を塗布するとともに、凸状曲面を外側に向けた状態で低熱伝導部材２４，２５を配置する。このような状態でフィルタコア部材２１及び低熱伝導部材２４，２５の外周面を互いにセラミック質シール材層１５を介して接着し、所定の乾燥を行う。その結果、図６（ｂ）に示すような断面円形状のセラミックフィルタ集合体９が得られる。

【００７６】上記のごとく、本実施形態の製造方法によれば、切削加工による外形カット工程を経ることなく所望形状のセラミックフィルタ集合体９を得ることができる。ゆえに、外形カット工程がない分だけ製造工程全体が簡略化され、比較的容易にかつ低コストで集合体９を製造することができる。また、製造時に切削屑が生じな

いため、周囲を汚す心配もないという利点もある。

【００７７】なお、本発明の実施形態は以下のように変更してもよい。

・　外形カット工程によって集合体９の全体形状を断面円形状に研削加工するのみならず、例えば以下のような断面円形状以外の形状に研削加工してもよい。図７（ｃ）には、研削加工を経て断面略おにぎり状に形成された集合体９が示されている。図８（ｃ）には、研削加工を経て断面略小判状（断面略トラック状）に形成された集合体９が示されている。勿論、集合体９の断面形状は略楕円状などであっても構わない。

【００７８】・　低熱伝導部材２２は、必ずしもフィルタコア部材２１の外側全体を完全に包囲するように配置されていなくてもよく、図８（ａ）～（ｃ）の別例のごとく外側の一部にのみ配置されていてもよい。

【００７９】・　フィルタコア部材２１の断面形状は、前記各実施形態のような断面矩形状のみに限定されることはなく、例えば図８（ａ）～（ｃ）の別例のように非矩形状（例えば略十字状）であってもよい。

【００８０】・　低熱伝導部材２２はフィルタコア部材２１の外側に１周のみ配置（即ち最外周にのみ配置）されていてもよいほか、２周以上配置されていてもよい。

・　各実施形態のようなセラミック材料製の低熱伝導部材２２に代えて、例えば金属製（特には多孔質金属製）の低熱伝導部材を採用することも可能である。

【００８１】・　低熱伝導部材２２の材料として、無機材料からなる多孔質体のみに限定されることはなく、無機繊維の凝集物などを用いてもよい。

・　フィルタコア部材２１を構成している柱状ハニカムフィルタＦ１は断面正方形状に限定されず、例えば断面長方形状、断面六角形状等であってもよい。

【００８２】次に、特許請求の範囲に記載された技術的思想のほかに、前述した実施形態によって把握される技術的思想を以下に列挙する。

（１）　多孔質炭化珪素焼結体からなる複数の四角柱状ハニカムフィルタの外周面同士を、炭化珪素を含むセラミック質シール材層を介して結束することにより、前記各ハニカムフィルタを一体化してなるフィルタコア部材と、軸線方向に沿って延びる多数のセルの端部が交互に封止された多孔質コーディエライト製の柱状ハニカム構造体からなり、前記フィルタコア部材の外側に配置された状態で同フィルタコア部材の外周面に、炭化珪素を含むセラミック質シール材層を介して結束された複数の低熱伝導部材とを備えるセラミックフィルタ集合体。

【００８３】

【発明の効果】以上詳述したように、請求項１～７に記載の発明によれば、強度及び再生効率に優れたセラミックフィルタ集合体を提供することができる。

【００８４】特に請求項５，６に記載の発明によれば、製造容易かつ比較的安価なセラミックフィルタ集合体を提供することができる。

【図面の簡単な説明】

【図１】本発明を具体化した第１実施形態の排気ガス浄化装置の概略断面図。

【図２】第１実施形態の排気ガス浄化装置に用いられるセラミックフィルタ集合体の正面図。

【図３】第１実施形態のセラミックフィルタ集合体の使用状態における断面図。

【図４】（ａ）～（ｃ）は第１実施形態のセラミックフィルタ集合体の製造手順を説明するための概略図。

【図５】（ａ）～（ｃ）は第２実施形態のセラミックフィルタ集合体の製造手順を説明するための概略図。

【図６】（ａ），（ｂ）は第３実施形態のセラミックフィルタ集合体の製造手順を説明するための概略図。

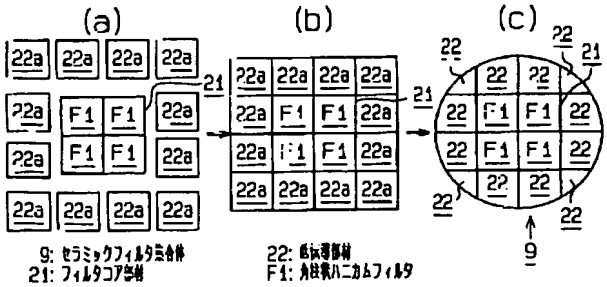
【図７】（ａ）～（ｃ）は別例のセラミックフィルタ集合体の製造手順を説明するための概略図。

【図８】（ａ）～（ｃ）は別例のセラミックフィルタ集合体の製造手順を説明するための概略図。

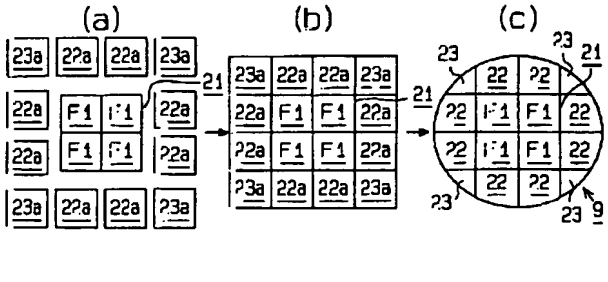
【符号の説明】

９…セラミックフィルタ集合体、１５…セラミック質シール材層、２１…フィルタコア部材、２２，２３，２４，２５…低熱伝導部材、２２ａ，２３ａ…柱状部材、Ｆ１…角柱状ハニカムフィルタ。

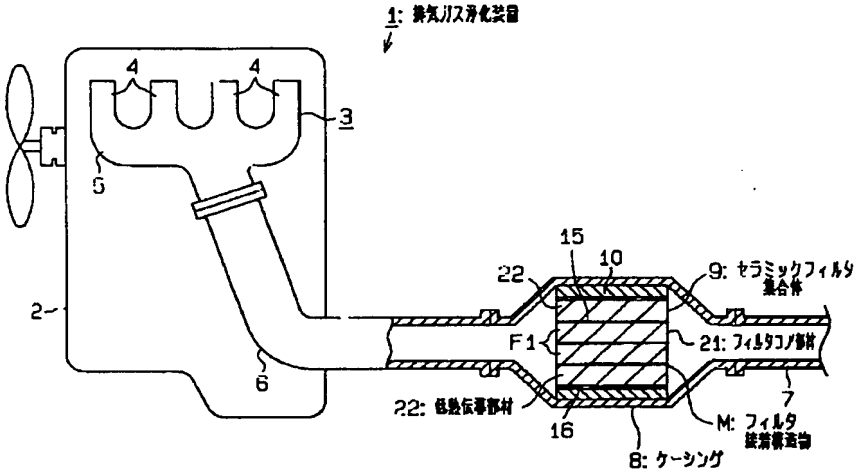
【図４】



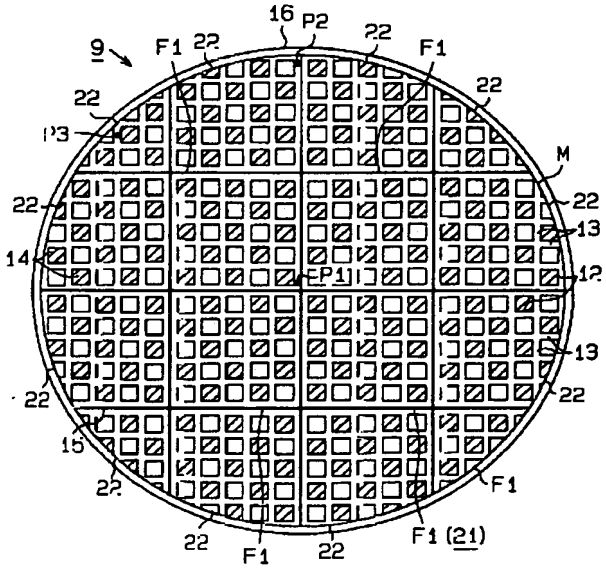
【図５】



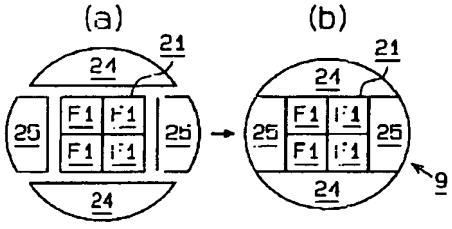
【図1】


1: 排気ガス浄化装置
4
4
3
5
2
6
15
10
22
9: セラミックフィルタ集合体
F1
21: フィルタユニット部材
7
22: 断熱保持部材
16
M: フィルタ接着保持物
8: ケーシング

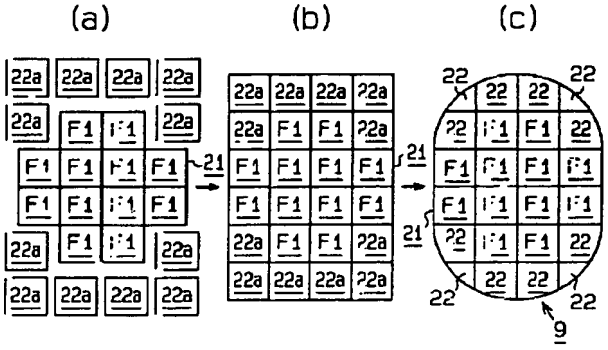
【図2】


16
P2
9
F1
22
22
F1
22
22
P3
M
22
22
13
14
12
P1
13
22
22
15
22
F1
22
F1
22
F1 (21)

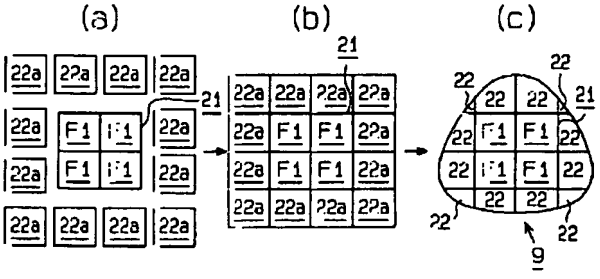
【図6】


(a)
(b)
21
24
25
F1
F1
25
24
21
24
25
F1
F1
25
24
9

【図8】


(a)
(b)
(c)
22a
F1
21
22
9

【図7】


(a)
(b)
(c)
22a
F1
21
22
9

【図3】